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Similarity judgment and feature weights

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SIMILARITY JUDGMENT AND FEATURE WEIGHTS

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SIMILARITY JUDGMENT AND FEATURE WEIGHTS

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This thesis project investigated the relationship of linguistic features and their modality, and the amount of change in similarity judgments within each age group and between age groups. Three triads of unfamiliar line drawings were presented to four-year-old preschoolers and college students. Participants were asked to judge which one of two line drawing stimuli is most similar to the target stimulus. In the control condition no linguistic labels were provided for the line drawings. In the experimental conditions linguistic labels were added in the form of spoken words, printed words or spoken and printed words. Linguistic labels were carefully "invented" considering the developmental level of typical auditory discrimination skills in four-year-olds.

The study consisted of a rhyming screen performed with preschoolers to examine rhyming skills, one control condition (no linguistic features presented), and three experimental conditions (added linguistic features). The order of experimental condition, presentation of triad I, II and III, placement (right or left side) of the stimuli choices, and

verbal instructions were randomized within the two age groups. Chi-square analyses were used for each triad and each experimental condition.

Results revealed emergent skills of phonological similarity detection and orientation towards similar sounding labels in preschool children, however their performance did not exceed chance level. The preschoolers' decisions were mainly based on visual perceptual features. In adults linguistic features overrode non-linguistic visual features in one triad when features were provided in verbal and printed form. Labels did not override non-linguistic visual features when only provided in verbal or printed form.

Conclusions for adult participants are that when labels are provided in verbal and printed form more attention is drawn to the label. These differences between adults and children may be attributed to differences in metalinguistic knowledge, developmental differences in the nature of the phonological lexicon in both age groups, different capacities of auditory short term memory and pre-literacy of preschoolers influencing their considerations of printed words.

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CHAPTER 1

Introduction

Perceptual development is one of the fundamental aspects of human growth and learning. Even before birth environmental stimulation is perceived and processed causing formation of neuronal networks, their differentiation and maturation (Moore, 2002). Nativists and empiricists in developmental psychology have revealed high perceptual competencies in infants, leading to increasing interest in investigating perceptual abilities of younger children than previous research had examined (Aslin & Smith, 1988). As Aslin and Smith (1988) pointed out, exploration of perceptual development becomes more delicate and easily confounded due to the increasing influence of cognition and language in older children. Clearly, perception incorporates more than a single psychological process, but rather consists of multidimensional aspects which also deserve attention from disciplines such as linguistics, anthropology, and philosophy.

Until recently, researchers have looked at perceptual development mainly from the psychological perspective and formulated hypotheses and discussions with little connection to closely related disciplines. For example, the disciplines of psychology and linguistics often were inspired by philosophical arguments (e.g. Fodor & Katz, 1964). These philosophical arguments provided common ground for empirical theories about perception. However, the focus of attention appeared constrained by discipline-specific perspectives and interests (Margolis & Laurence, 1999).

While linguists frequently analyzed perception in relation to the acquisition of linguistic concepts, developmental psychologists often dedicated themselves to finding

out how perception relates to cognitive processes of classification, categorization, conceptualization and memorization of environmental stimuli. Only recently have researchers in multiple disciplines begun to link their findings in order to develop integrated theories about perceptual, cognitive, and linguistic development (Margolis & Laurence, 1999). As perceptual, cognitive and linguistic processes are closely related, examining the nature of perceptual development requires an analysis from both the linguistic and cognitive perspective.

This research study focused on similarity as a specific element of human perception. Similarity carries a special standing in perceptual development because it is based on selective attention to specific features. Similarity can be understood as the by-product of classification processes and is an unconscious cognitive entity (Thomas & Mareschal, 1997). With the help of similarity judgment tasks, it is possible to externalize the otherwise internal process to a metacognitive level (Thomas & Mareschal). Examining the performance of children and adults in similarity judgment tasks can give valuable information about information processing at different developmental stages and may offer further insights about the nature of cognitive functions. Therefore, the current research was also concerned with the nature of similarity judgment from a developmental standpoint.

Language learning is based on perceptual similarity. It is a widespread assumption that children learn words as labels for their conceptual categories (Malt, Slowan & Gennari, 2003). When adding labels to conceptual categories derived from classification relying on perception, these linguistic labels convey conceptual knowledge and assume a

certain degree of perceptually detectable similarity. This demonstrates the close relationship between perception, cognition and language. Further, categorizing objects subsequently leads to generalization and inferences among category members (Estes, 1994)

Studies of early childhood language suggest that younger children consider the linguistic label a feature of the object just like other perceptual features rather than a symbol of the object (Vygotsky, 1986). The label-as-attribute model also suggests that linguistic labels convey more salience than other features and consequently have greater contributions to similarity judgment (Sloutsky, Lo, & Fisher, 2001).

Sloutsky and Lo (1999) were able to present data that reflected the developmental nature of linguistic feature weights. They performed similarity judgment tasks with younger and older children to see how a shared label would impact the judgment of line drawings. The study provided evidence that five- to seven-year –old young children relied the most on linguistic features during judgment tasks. The older the children, the less reliance on the linguistic feature was observed. Older children rather based their decision on visual similarity. Sloutsky and Lo (1999) concluded that verbal labels are salient features for young children due to a general preference for the auditory channel at this young age or due to a special standing of language drawing more attention to young children.

It can also be argued that linguistic features were more salient than visual features because of the nature of the features. In Sloutksy and Lo's study (1999) linguistic features were attached to a triad of pictures so that two pictures shared the *same* linguistic

label and one picture received a *different* label. Participants did not have to detect similarity among visual features *and* linguistic features since linguistic features were either the same or different. Therefore it can be argued that existence of *equivalence* among linguistic feature tempted the young children to base their decision on those rather than on visual non-linguistic features.

Two questions evolving from the previous studies were investigated in this current research: Would the preference for auditory features remain when analysis requires *similarity detection* among visual *and* linguistic features? Would age have an effect on preference for linguistic features under this condition?

CHAPTER 2

Review of the Literature

Similarity detection carries a special standing in perceptual development because it is based on selective attention to specific features. The term similarity can be defined as a product evolving during classification processes (Thomas & Mareschal, 1997). Therefore, similarity is central to cognitive functions, such as categorization, memorization, and learning (Sloutsky & Lo, 1999; Estes, 1994; Medin, Goldstone, Gentner, 1993).

It is important to differentiate between classification and categorization processes. Classification implies partitioning a collection of stimuli into groups by feature comparison (Estes, 1994) and therefore only demands a perceptual analysis of the stimuli. Categorization on the other hand requires grouping stimuli by using conceptual knowledge (Estes, 1994) that may deviate from the mere perceptual structure (Smith, 1989). Similarity judgments hold valuable information by externalizing the otherwise internal process of feature comparisons (Thomas & Mareschal, 1997).

There is evidence that similarity judgment take developmental changes. What seems to be similar for adults is not necessarily judged as being similar by children. This is related to the different experiences and cognitive capacities of adults and children. For example, it becomes apparent in sorting tasks. At an early age children categorize objects based on an overall, general impression. Their non-analytic or holistic style changes with cognitive growth to a more adult-like, analytic, feature oriented categorization style as they begin to attend to specific perceptual features (Alexander & Enns, 1988; Aslin &

Smith, 1988; Smith, 1989). Children begin to compare objects by attending to one specific feature. Then children develop the ability to attend to multiple features at once and categorize on multiple dimensions (Inhelder & Piaget, 1964).

Language learning is based on perceptual similarity. It is a widespread assumption that children learn words as labels for their conceptual categories (Malt, Sloman, & Gennari, 2003). Indeed, all people tend to give objects that are similar the same linguistic label and include them into the same category. For example, football, baseball, and golf ball are all categorized as "ball". Rosch and Mervis (1975) provided evidence that objects within a linguistic category contain a graded amount of common perceptual features that allow for similarity detection among these members. Therefore, when adding labels to conceptual categories derived from classification relying on perception, these linguistic labels convey conceptual knowledge and assume a certain degree of perceptually detectable similarity. This demonstrates the close relationship between perception, cognition and language. Further, categorizing objects leads to generalization and inferences among category members (Estes, 1994). Landau, Smith, and Jones (1997) supported the dynamic nature of classification processes and similarity detection. They reported developmental differences between 2- and 3-year-old children in the use of pseudowords, which served as labels for novel objects. When independently generalized to other unfamiliar objects 2-year-old children relied on the overall similarity of the unfamiliar objects, whereas 3-year old children were able to attend to size, shape, or texture and based their decisions on the dimension (feature) where commonality was detected, not just overall similarity. The developmental shift from a non-analytical,

holistic style to a feature oriented process in categorization tasks was evident in the labeling performance with pseudowords (Landau, Smith, Jones, 1997).

In the same way as visual perception, speech perception also takes its developmental course from a holistic to a feature analysis process during childhood. This is evident during the development of phonological awareness. At first children learn words in a holistic manner (Carroll, Snowling, Hume, & Stevenson, 2003). Phonological sensitivity increases with lexical growth in children. This is because "there is mounting pressure to develop a network of interrelated word shapes, which will allow the child to make better use of the temporal structure of on-line word recognition". (Jusczyk, 1986 as cited in Vihman, 1996, p. 169) The change from a more holistic word-specific pattern to a phonological rule based production occurs during the third year of life. Interestingly, this is also the time when children begin to process visual stimuli in a more analytical way as the earlier mentioned study by Landau, Smith, and Jones (1997) and the following study by Alexander and Enns (1988) support. Alexander and Enns (1988) found that children at age 3 formed categories of perceptually based characteristics, however the children were motivated by interrelations of visual features rather than individual visual features (e.g. "They look like a family" p. 1383). Further they reported that at age 5 categorical decision making became more adult like and categories were more often based on conventional features.

Given the fact that there are various ways to classify and categorize, it elucidates that similarity is not a clear cut, binary constant that can be judged either right or wrong. Children have logical, but non-analytic based explanations for their yet unconventional

categories (e.g. their typical "errors" of under- and overextensions), while adults practice a conventionally based classification and categorization style grounded in necessary and sufficient features. Indeed, as Medin, Wattenmaker and Hampson (1987) found, adults demonstrate a preference for basing their categories on salient features. In their study adults categorized objects based on common features instead of categorizing them on a nonanalytical notion by thematic relations. However, when adults were asked to use thematic relations, they were readily able to do so.

This example demonstrates that similarity is by nature a highly dynamic and context dependent entity (Medin, Goldstone, & Gentner, 1993; Tversky, 1977; Sloutsky & Lo, 1999). Items that are highly similar in one moment, can be rather different in the next. As Smith (1989) stated: "Similarity is a much maligned concept: It is characterized as, at best, a badly behaved relation." (p. 141). The salience or weight of features changes with context (Tversky, 1977). Consequently, a feature can never contain a static value. However, in a given context entities jointly constrain one another and convert the similarity judgment process into a feature comparison task with constant feature weights (Medin, Goldstone & Gentner, 1993).

Since there are many ways objects can be compared to each other, an important question to ask is always in what way objects are compared. Smith (1989) agrees by stating: "Given a constant weighting scheme and valuing function, similarity may be a well-behaved relation." (p. 142). There are certain conventional rules individuals of one culture base their similarity judgments on and children are on a perceptual journey throughout childhood to acquire these rules.

Similarity becomes especially slippery when language becomes involved. That means it is even harder to grasp and explain similarity when dealing with linguistic labels. Linguistic labels are viewed as special entities because they can impact our perception by adding non-perceivable, conceptual knowledge to perceptually detectable features. Thus, things that are by their appearance not considered similar can be considered as members of the same category due to their shared linguistic label. For example, judging a penguin and a crow as similar is motivated by their shared linguistic concept "bird" rather than by visual feature analysis.

Since linguistic concepts have to be acquired throughout childhood, the influence of perception on language and vice versa is of great interest to researchers. Studies of early childhood language suggest that younger children consider the linguistic label a feature of the object just like other perceptual features rather than a symbol of the object (Vygotsky, 1986). The label-as-attribute model also suggests that linguistic labels convey higher feature values than other features and make greater contributions to similarity judgment (Sloutsky, Lo, & Fisher, 2001).

Sloutsky and Lo (1999) were able to present data that reflected the developmental nature of linguistic feature weights. They conducted a research study to analyze the effect of linguistic features on similarity judgement with line drawings (faces) among 6 to 12 year old children. For all ages they assumed that the participants considered the label a feature just like other perceptual features. They used schematic faces as stimuli. One set of stimuli contained a triad of faces including two test stimuli and one target. The linguistic feature was a nonsense word. The same nonsense word was assigned to one of

the test stimuli and the target, a different nonsense word was assigned to the other test stimuli. Participants were asked to judge which one of the test stimuli was more similar to the target. The results of this study provided evidence that 5 to 7-year-old children relied most on the linguistic feature of the stimuli for their judgement. The older the children, the less reliance on the linguistic feature was observable and increasingly greater reliance on visual similarity was evidenced.

These outcomes underlined the hypothesis that the feature weight of linguistic labels undergo developmental changes. A possible explanation may be that children acquire the knowledge that linguistic labels are arbitrary and function as symbols. Therefore, the status of the linguistic feature changes from an object property and becomes a self-existing entity marking linguistic categories with conceptual value and meaning depending on context.

In their discussion, Sloutsky and Lo (1999) addressed several alternative explanations for the outcome of their study. The most important one was that the salience of linguistic features may stem from a preference for the auditory over the visual channel. Younger children may have a domain specific preference and allow auditory input more attention and subsequently assign higher feature value to the heard label.

By maintaining the same modality Sloutksy and Lo (1999) compared the impact of linguistic versus non-linguistic features. They replaced the spoken words with hand-signs taken from American Sign Language as a visual linguistic feature. The handsigns were presented in print above the stimuli and target. They did not impact the similarity

judgment in the same significant way as the spoken word. Therefore, a preference for linguistic features (visual meaningful signs) over other visual features could not be found.

In their most recent research study, Sloutsky and Napolitano (2003) further investigated the question of preference. In this experiment they used landscape pictures as stimuli and unique simple tones, which differ in timbre (sine, triangle and sawtooth) for auditory stimuli. This time the participants were 4- to 5-year-old children and undergraduate college students. The task was the same as used by Sloutsky and Lo (1999). The outcome underlined their earlier result: children assign more feature weight to auditory input than undergraduate students. However, since the auditory stimuli were non-linguistic in nature in the second study, the researchers were only able to demonstrate the preference of the auditory channel over visual channel. They have not addressed the question whether verbal labels actually guide and constrain feature analysis in such a strong manner that they could override visual features.

Another plausible explanation for the preference of the auditory channel only tangentially mentioned by Sloutsky and Lo (1999) may be the different difficulty level of feature analysis. They discussed verbal labels as serving as a possible "tiebreaker" when lacking sufficient confidence to rely exclusively on visual features. In both studies auditory stimuli were assigned to visual stimuli so that two auditory stimuli were exactly the *same*, and one was *different*. The preference for auditory information may be a result of the lower difficulty level to detect *equivalence* among auditory features compared to the difficulty in similarity detection among visual features.

Two questions evolving from the previous studies were investigated in this current research: Would the preference for auditory features remain when analysis requires *similarity detection* among visual *and* auditory features? Would age have an effect on preference for auditory features under this condition?

Hence, this study was conducted in order to move one step closer to answering the question whether linguistic features are assigned more feature weight than visual features of line drawings in similarity judgment tasks. Therefore, this study examined the effect of auditory and visual linguistic features (in the form of spoken and printed words) and visual features (in the form of line drawing designs) on similarity judgment. However, in this study the linguistic features did not match, but they rhymed. This way the participant had only the option to analyze the given features for similarity in both modalities (auditory and visual). Further, this experiment was conducted to examine whether age has an influence on feature weights and modality salience.

Given the change of the condition for the auditory channel compared to the previous experiments of Sloutsky and Lo (1999) as well as Sloutsky and Napolitano (2003) the following null hypotheses were evaluated:

1. Considering each triad as a separate entity, the effect of an added verbal label on similarity judgment of line drawing designs does not exceed the chance level (50%) within each age group.
2. Considering each triad as a separate entity, the effect of an added printed label on similarity judgment of line drawing designs does not exceed the chance level (50%) within each age group.

3. Considering each triad as a separate entity, the effect of an added verbal and printed label on similarity judgment of line drawing designs does not exceed the chance level (50%) within each age group.
4. Considering each triad as a separate entity, no relationship can be observed between the amount of changes in similarity judgment after adding verbal labels compared to adding printed labels within each age group.
5. Considering each triad as a separate entity, no relationship can be observed in the amount of changes in similarity judgment after adding a verbal label compared to adding a verbal and printed label within each age group.
6. Considering each triad as a separate entity, no relationship can be observed in the amount of changes in similarity judgment after adding a printed label compared to adding a verbal and printed label within each age group.
7. Considering each triad as a separate entity, no relationship of age can be observed in similarity judgments of line drawing designs between preschoolers and adults.
8. Considering each triad as a separate entity, no relationship can be observed in the similarity judgments of line drawing designs between preschoolers and adults after adding a verbal label.
9. Considering each triad as a separate entity, no relationship can be observed in the similarity judgments of line drawing designs between preschoolers and adults after adding a printed label.

10. Considering each triad as a separate entity, no relationship can be observed in the similarity judgments of line drawing designs of between preschoolers and adults after adding a verbal and printed label.
11. Considering each triad as a separate entity, no relationship can be observed in similarity judgments of line drawing designs between preschoolers and adults after adding a verbal label compared to a printed label.
12. Considering each triad as a separate entity no relationship can be observed in similarity judgments of line drawing designs between preschoolers and adults after adding a printed label compared to a verbal and printed label.
13. Considering each triad as a separate entity, no relationship can be observed in similarity judgments of line drawing designs between preschoolers and adults after adding a verbal label compared to a verbal and printed label.

CHAPTER 3

Methods

This study explored the status of the linguistic feature in two age groups and closely paralleled the experiments by Sloutsky and Lo (1999) and Sloutsky and Napolitano (2003). Sloutsky and Lo's experiments revealed that 5-7-year-old children based their decision during similarity judgment mostly on verbal labels, whereas older children decreasingly relied on labels and rather based their decision on visual features of line drawing designs.

Sloutsky and Napolitano (2003) further explored the question about the general auditory or linguistic preference in two age groups. The results underlined a significant preference for auditory stimuli in younger children (4 years) compared to undergraduates. However, Sloustky and Napolitano (2003) used tones (i.e. sirens) and not linguistic features. Their findings were not conclusive regarding the preference for auditory stimuli. Are younger children geared to auditory information because of their language acquisition stage? This could be an explanation for the attention given to the labels in the first study. Or are they attending to general auditory stimuli due to the developmentally earlier maturing auditory channel? This would explain their preference for general auditory features in the second study.

There are further investigations warranted in similarity judgments and their dynamics. The purpose of this study was to continue earlier research as a stepping stone toward more insights in the development of perception, classification and feature

weights. Further, the effect of added labels in their special role as a linguistic feature and the effect of age were of particular interest in this study.

Participants

A total of 43 participants were included in this study. Twenty participants (7 males and 10 females) were children within the age range of 4;1 to 4;11 years (*M.*= 4.5 years; *SD* = 0.37) enrolled in the University of Nebraska at Omaha (UNO) Child Care Center. Upon agreement of staff from the Child Care Center, IRB parental consent forms were passed out to all parents of children who matched the age range of 4;1 to 4;11 years. Twenty parental consent forms were returned to the UNO Child Care staff. Of the 20 children, 2 children were excluded in the data analysis due to their bilingual background and 1 child did not complete all testing activities due to repeated absences during testing times.

A total of 23 participants (1 male and 17 females; *M* = 26.7 years, *SD* = 0.42; range 20;9 to 47;05 years) were undergraduate and graduate students. They were enrolled in the course "Language Development and Disorders For Teachers" in the College of Education at the University of Nebraska at Omaha. After receiving permission from the professor teaching this course participants were recruited by passing out "flyers" of IRB adult consent forms and presenting the main theme of the study at the beginning of class. The students were naive to the purpose of examining the specific effect of language on similarity judgment to avoid bias of participants. Five students were excluded from the data analysis due to their repeated absences during testing times.

Settings

The children were tested in a small room in the UNO Child Care Center building. The office room was equipped with a desk, a chair, file drawers, a small table, and one chair appropriate to the size of young children and one chair of regular size for the examiner. The same staff member of the Child Care Center who was acquainted with the children was present during the testing. During the first two sessions the secondary investigator was also present during the testing.

Undergraduate students were tested at the University of Nebraska at Omaha in a quiet individual treatment room of the speech and hearing clinic. The room was equipped with a table and two chairs of appropriate size for adults.

Experimental Design

Independent Variables

The independent variables included the age of the participants. Second, three different triads of line drawing designs were used to determine if there was a difference in similarity judgment due to variances in the line drawing designs (abstractness or complexity of visual stimuli). Third, the use of verbal and printed labels was examined to determine if there was a differential effect of modality.

The recruiting criteria for preschoolers in this study was to be between 4 years and 4 years and 11 months of age. This age range was chosen because of the reported outcomes in prior studies by Sloutsky and Lo (1999) and Sloutsky and Napolitano (2003) for preschoolers within this age range.

Dependent Variables

The dependent variable included the percentages of change in the participants' similarity judgments. For example, if the participant chose test stimulus A to be most similar with the target when no linguistic feature was given and then chose test stimulus B to be most similar with the target when a linguistic feature was given (i.e. verbal label), the number of changes within one triad of pictures was measured as one.

Materials

Three triads of line drawing designs from an earlier study of Medin, Goldstone, and Gentner, (1993) were used as visual, non-linguistic stimuli (see Appendix A). Each triad set consisting of two test stimuli (A and B) and one target (T) of black-and-white line drawing designs were placed on a 28 cm x 20.3 cm cream colored file folder. Line drawings of triad I and II were 3.2 cm x 3.2 cm. Line drawings of triad III were 3.2 cm x 2.5 cm. The triads contained the same amount of common features. In addition, stimulus A and target T both shared one critical distinctive feature and stimulus B and target T shared another critical distinctive feature.

The line drawing designs of Medin, Goldstone and Gentner (1993) were chosen because they met all the requirements for good visual nonlinguistic stimuli in this study. First, each design was two-dimensional, simple and non-ambiguous in nature. Second, their appearance was somewhat comparable to familiar objects (such as a comb or crown, a spider web or Indian dream catcher, and molecule model or "tinker toy". This way, the line drawings were not spontaneously nameable despite their somewhat familiar appearance. Neither was the appearance too abstract as evidenced by the children's

spontaneous verbalizing of associations triggered by line drawings (e.g., "This looks like a crown, a planet, the letter "Z").

Linguistic labels (pseudowords) were carefully "invented" using the following considerations: First, the critical distinctive feature sounds used in the rhyming pseudowords had to meet the developmental level of typical auditory discrimination skills in 4 year olds. Therefore /k/ and /p/ were used in the rhyming pair /kito/ and /pito/. The only phonological feature being varied in this minimal pair is the location of the plosives /k/ and /p/. The non-rhyming word was created using the first syllable of the label of the rhymed test stimulus, in this case /ki/ and was placed as the second syllable of the non-rhyming pseudoword, in this case /saki/. The non-rhyming label /saki/ shared the syllable /ki/ with the rhyming test stimulus and the vowel /i/ with the target label. The minimal pair /guga/ and /luga/ differentiated in two phonological features (location and a plosive vs. a liquid). The non-rhyming label /migu/ shared the syllable /gu/ with the rhyming test stimulus and the vowel /u/ with the target label. In the third triad /nami/ and /fami/ differed in three phonological features: nasality, location, and voice. The non-rhyming label /suna/ shared the syllable /na/ with the rhymed test stimulus /nami/ and the vowel /a/ with the target /fami/.

Printed labels were also visually more similar in the rhyming labels due to only differing in one grapheme. Pseudowords were invented with consideration to following strictly 1:1 grapheme-phoneme conversion (one letter is one sound, not two letters equals one sound as in /sh/).

Procedures

The study consisted of one control condition (no linguistic feature) and three experimental conditions (added linguistic features). The experimental conditions included verbal labels, printed labels, and both verbal and printed labels. In all four (one control and three experimental) testing sessions, the participant was presented with all three sets of line drawing designs. The participant was asked to pick the test stimulus that "goes best with" the target and to indicate his/her choice by pointing to test stimulus A or B.

The control condition was given to all participants on the first day of data collection and served as a baseline. In the following testing session the participants were randomly assigned to one of the three experimental conditions (Appendix B; Table B1) to control for ordering effect. There was a break of at least one day between each condition for the preschoolers and one week for the adults. Testing lasted over a period of one and a half weeks for preschoolers and five weeks for students.

Control Condition

In the control condition, only the line drawing designs (visual, non-linguistic features) were shown to each participant. The line drawings were presented in triads. A set of three line drawing designs were placed inside a cream colored folder. This way all pictures were visible for the same amount of time and the arrangement of the three pictures did not vary between participants. Each participant was presented with a total of three triads, one triad (test stimulus A, B and T) of line drawing designs at a time. The order of presenting the triads also was randomized (see Appendix B; Table B2) to control for an effect of the order in which the line drawing designs were presented.

The following instruction was given to each participant before showing the pictures: "I want you to look at all the pictures and then show me which two go together." Then the folder was opened and the triad of two stimulus cards and the target was presented along with the question: "Which one goes with this one (point to the target)?". If the participant needed prompting the following prompt was provided: "Show me which one of these (hand movement over the two stimulus items) goes best with that one (point to the target)."

In order to control for bias of side preference (right or left side), the side of stimuli placement was randomized among the participants within each age group (see Appendix B, Table B3). Thus, the stimulus item A or B was not always positioned on the same side of the arrangement.

Experimental Condition

Adding verbal labels.

In one of the three experimental conditions a verbal label (spoken word) was added to each of the two test stimuli and the target of each triad set. The verbal label was a bi-syllabic pseudoword. The verbal label of the target rhymed with only one of the two test stimuli. The rhymed verbal label was assigned to stimulus A or B according to each individuals' decision in the control condition. In order to measure a change in similarity judgment as an effect of linguistic labels, the rhyming word was always assigned to the test stimulus that was judged less similar in the control condition where no linguistic feature was given. Thus, the rhyming labels were not placed the same way for each participant, but based on individual similarity judgment patterns in the control condition.

In this way it was possible to relate a change in the similarity judgment to the effect of the linguistic label and make comparisons that could be used to derive information about visual or auditory feature weights.

For Example:

Adult Participant # 01 selected test stimulus B in the control condition of triad II. Therefore, she was presented with the following triad and given the verbal labels as spoken words only (adding verbal labels):

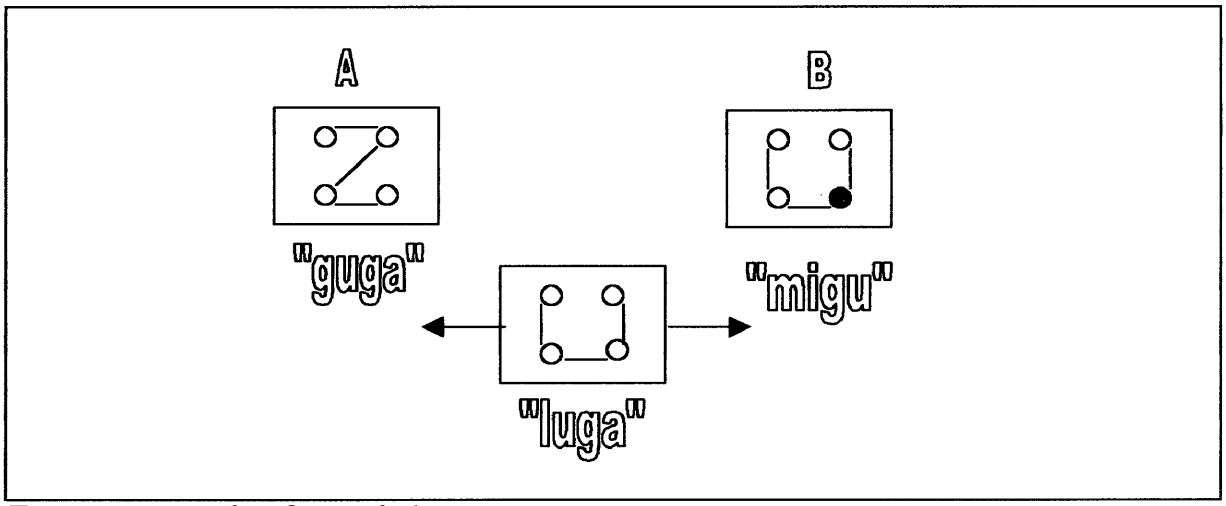


*Figure 1.*Example of test triad.

Adding verbal and printed labels.

In the experimental conditions where verbal labels were added and in the experimental condition where verbal and printed labels were added the following instruction was given to the participant before opening the folder with the pictures: "I will

show you pictures and I will tell you something about them. Wait until I'm done telling you about the pictures. Then you can show me which two pictures go best together?" The folder was opened and the triad of line drawings presented by saying: "This is a luga (point to the target). This is a migu (point to test stimulus). This is a guga (point to test stimulus). Does this guga (point to test stimulus) go with this luga (point to the target), or does this migu (point to test stimulus) go with this luga (point to the target)?" (Version 2: This is a luga (point to the target). This is a guga (point to test stimulus). This is a migu (point to test stimulus). Does this migu (point to test stimulus) go with this luga (point to the target), or does this guga (point to test stimulus) go with this luga (point to the target)". The versions of instructions was randomized (Appendix B; Table B4) to control for the effect of saying the rhyming pair first or last and creating a bias for the best remembered pair. Again, the labels for the test items (i. e. "guga" and "migu") were added either to stimulus A or B depending on the individual's choice in the control condition with the difference being that in the verbal label condition the linguistic features were only provided auditorily whereas in the verbal and printed label condition the linguistic features were provided auditorily and visually.

Adding printed labels.

In this experimental condition printed labels were added to each of the two test stimuli and the target. The printed labels were the same bi-syllabic pseudowords given as verbal labels. The printed labels were placed beneath each picture (Lucida Sans Unicode; font size 20; bold). The rhyming words were assigned to either stimulus A or B

depending on each individual and his/her decision in the control condition (the same as for the other two experimental conditions). The following instruction was given before the folder with the pictures was opened: "I will show you some pictures and I want you to look at all the pictures first and then show me which two go together?" Then the folder was opened and the triad of line drawings was presented along with the instruction: "Which one goes best with this one (point to the target)?". If the participant needed prompting the following prompt was provided: "Show me which one of these (hand movement over the two stimulus items) goes best with that one (point to the target)". The same folders was used for the experimental condition with printed labels and the experimental condition with verbal and printed labels. The only difference was that in the printed label condition no labels were read to the participants and in the verbal and printed label condition the labels were read to the participants as described above.

Warm-up Sets and Rhyming Screening

On the first day, a warm-up set was given to all participants (to assure that the task was understood). The warm-up set included five trial sets of triads consisting of two test stimuli (A and B) and a target (T). The warm-up set did not include any verbal or visual labels.

In addition, one day prior to the first presentation of line drawing designs the preschoolers were given a task to identify rhyming words. Pairs of rhyming and non-rhyming bi-syllabic words were used to determine rhyming skills of the preschoolers (see Appendix B). This was done to establish developmental readiness for the matching tasks required for the research.

Data Analysis

Within Group Analysis

Null Hypotheses 1-6 addressed the relationship between modality of linguistic features and amount of change in similarity judgment within each age group. To address Null Hypotheses 1, 2, and 3, percentages were calculated for each triad to determine if there was a difference in similarity judgment on line drawings with and without linguistic features being given. For Null Hypotheses 4, 5, and 6, percentages were calculated for each triad and a chi-square analysis was used for each triad to determine if the modality of linguistic labels (auditory, visual or both) had an effect on participants' similarity judgment.

Between Group Analysis

To address Null Hypothesis 7, the percentage of participants who chose test stimulus A to be most similar to the target and the percentage of participants who chose test stimulus B in the control condition (no linguistic labels given) was determined for each triad. The percentages of the two age groups were compared using a chi-square analysis for each triad to determine if there is a significant effect of age on participants' judgment.

In order to address Null Hypotheses 8, 9 and 10, the percentage of participants who changed their mind about which test stimulus was more similar to the target was calculated for each triad and each experimental condition (linguistic labels given). The percentages of change in the two age groups were compared using a chi-square analysis.

Null Hypotheses 11, 12, and 13 were included to address the possible relationship between the amount of change in each age group and the modality of the linguistic labels (auditory, visual or both). The percentages of change in each triad and in each experimental condition was calculated. These were compared between two age groups using a chi-square analyses for each triad.

CHAPTER 4

Results

The results of this research study are presented by first displaying the outcomes for each triad in the control condition and the three experimental conditions within each age group. The statistical analysis follows, examining relationships between the experimental conditions within each age group. Finally, between group comparisons for all four conditions (control and three experimental conditions) will be reported.

Rhyming Screening and Warm-Up Trials

The rhyming screening was conducted prior to the data collection to examine the children's ability to identify rhyming pairs and non-rhyming pairs of bi-syllablic words (Appendix C). Table 1 lists the results of the screening.

Table 1. Rhyming Screening results - Pretesting

Code	Gender	Age	1	**2**	**3**	4	**5**	Correct
01	F	4;02				F		4
02	F	4;11		**F**	**F**		**F**	2
03	F	4;11		**F**				4
04	M	4:10		**F**	**F**	F		2
05	M	4;10	F			F		3
06	F	4;11		**F**	**F**		**F**	2
07	F	4;01	refused					0
08	M	4;01	refused					0
09	M	4;02				F		4
10	M	4;03		**F**	**F**		**F**	2
11	M	4;04						**0**
12	M	4;01		**F**				4
13	F	4;07	F			F		3
14	F	4;07		**F**	**F**		**F**	2
15	F	4;04			**F**	F	**F**	2
16*BL	M	4;06	F	**F**	**F**		**F**	1
17	F	4;01		**F**				4
18*BL	M	4;01		**F**	**F**		**F**	1
19	F	4;11		**F**		F		3
20	F	4;10		**F**	**F**		**F**	2

*BL= Bilingual ; F= False (error) ; bold = Rhyming Pairs

None of the preschoolers were able to achieve 100 % accuracy on the rhyming screening. Only 5 of the 20 children were able to identify rhyming pairs with 80% (4 of 5) accuracy. Due to the preschoolers' low success rate another rhyming screening was administered upon completion of the experiment. This time the rhyming task included monosyllabic and bi-syllabic rhyming and non-rhyming words pairs and rhyming and non-rhyming bi-syllablic pseudowords that were used in the study as linguistic features. Results are displayed in Table 2.

Table 2. Results of Rhyming Screening – Posttesting

Code		Age	W1	W2	1	2	3	4	5	6	7	8	Score
1**	f	4;02	+	+	-	+	-	+	-	+	+	+	5
2	f	4;11	+	+	-	+	+	-	-	+	+	-	4
3**	f	4;11	+	+	+	+	-	+	-	+	-	+	5
4	m	4:10	+	+	-	+	+	-	+	+	-	-	4
5	m	4;10	+	+	+	+	-	+	-	+	-	+	5
6	f	4;11	+	-	+	+	-	+	-	+	-	+	5
7	f	4;01	+	+	+	+	-	+	-	+	-	+	5
8	m	4;01	+	+	+	+	+	-	+	-	-	-	4
9**	m	4;02	+	+	+	+	-	+	+	+	+	+	7
10	m	4;03	+	+	+	+	-	+	-	+	-	+	5
11	m	4;04	+	+	-	-	+	+	-	-	+	+	4
12**	m	4;01	+	+	+	+	-	+	-	+	-	+	5
13	f	4;07	+	+	+	+	-	+	-	+	-	+	5
14	f	4;07	+	+	-	+	+	+	+	+	+	+	7
15	f	4;04	+	+	+	+	-	+	-	+	-	+	5
16*BL	m	4;06	+	+	-	+	-	-	+	-	+	-	3
17**	f	4;01	-	-	+	+	+	+	+	+	+	+	8
18*BL	m	4;01	-	-	+	+	-	-	-	-	-	-	2
19	f	4;11	+	+	+	+	+	+	+	+	+	+	8

*BL = Bilingual; f = female; m = male; W1/W2 = warm-up rhyme; "- " = error, "+" = correct; gray = rhyming pair; **= scored with 80% (4 of 5) accuracy on pretest screening.

In the posttest rhyming task two preschoolers achieved 100% (8 of 8) accuracy. Two preschoolers identified rhyming and non-rhyming pairs with 87.5% (7 of 8) accuracy. Two of the 4 preschoolers who achieved 80% accuracy on the pretest identified rhyming and non-rhyming pairs with 87.5% and 100% accuracy on the posttest. In both screenings the age of the preschoolers who achieved scores equal to or above 80% accuracy varied from 4;1 to 4;11 years.

Warm-up trials were conducted to familiarize the participants with the task and clarify the task when necessary. None of the preschool or adult participants required further instructions to complete the similarity judgment tasks. Also, there was a high consistency in the responses among the adults and preschoolers. In adults only 2% of all warm-up responses differed and only 9% of all preschoolers responded differently than the majority.

Within Group Analysis

Control Condition - Preschoolers

Table 3 displays the results of similarity judgment in the control condition (no linguistic features). In triad I 17.65% of the preschoolers found test stimulus A most similar to the target whereas 82.35% judged test stimulus B most similar. In triad II almost a third of the preschoolers (29.41%) decided on test stimulus A and nearly two thirds (70.59%) found test stimulus B to be more similar to the target. In triad III the preschoolers are nearly equally divided in their decision regarding which test stimulus is most similar to the target (52.94% for A and 47.06% for B). It is note worthy that the speed of the similarity judgment in all three triads was very fast. The children pointed to

either stimulus A or B readily without much hesitation. Subjectively, the majority of the preschoolers appeared very sure of their decisions.

Table 3. Results of Control Condition - Preschoolers

Choices:	Triad I	Triad II	Triad III
A most similar to T	17.65%	29.41%	52.94
B most similar to T	82.35%	70.59%	47.06

n = 17

Control Condition - Adults

Table 4 displays the results of similarity judgment in the control condition (no linguistic features). The results were very similar across all triads. In triad I and II only one of the adults (5.56%) found test stimulus A most similar to the target whereas 17 (94.44%) judged test stimulus B most similar. In triad III two adults (11.11%) decided on test stimulus A and 16 adults (88.89%) found test stimulus B to be more similar to the target. The majority of adults pointed to either stimulus A or B readily without much hesitation. Subjectively, however, the response time of adults appeared slower compared to preschoolers. It also was noted that some adults (#6, 12, 14, 21) completed their judgment by discussing out loud why both choices would be legitimate. It is worth noting, that most of these participants were older than the average adult participant (38;03 years).

Table 4. Results of Control Condition - Adults

Choices:	Triad I	Triad II	Triad III
A most similar to T	05.56%	05.56%	11.11%
B most similar to T	94.44%	94.44%	88.89%

n = 18

The Effect of Linguistic Labels - Preschoolers

Adding verbal labels.

When verbal labels were added to line drawing designs results were as follow:

Table 5. Adding Verbal Label - Preschoolers

Choices:	Triad I	Triad II	Triad III
A most similar to T	35.29%	41.18%	52.93%
B most similar to T	64.71%	58.82%	47.07%

n = 17

In triad I there was an increase in the number of preschoolers (35.29%) who assign stimulus A more similarity to the target than during the control condition. There was a concomitant decrease in the number of preschoolers (64.71%) who judge stimulus B as more similar to the target.

In triad II 41.18% of the preschoolers now decided that stimulus A was most similar to the target and 58.82% find B most similar to the target. In triad III it appeared as if none of the preschoolers have changed their mind about the similarity of the line drawing designs. That is not accurate, however. Although the number of preschoolers who chose A was the same as in the control condition (52.93%), there were participants

who changed from choosing A in the control condition to choosing B in this experimental condition where verbal labels were added. At the same time participants who had chosen B in the control condition (47.07%) changed their mind to A after being provided with a verbal label for the line drawing designs. In Triad III it happened to be the case that these changes canceled each other out when looking only at the percentages of choices for A and B. Therefore, the number of changes from the no-label condition (control condition) to verbal label experimental condition are listed in Table 5.

Table 6. Changes After Adding Verbal Labels

	Triad I	Triad II	Triad III
Changes	17.65%	23.53%	11.77%

n = 17

Table 6 shows that most of the changes after adding a verbal label occurred in triad II, followed by triad I and triad III had the least amount of change in similarity judgments after adding a verbal label. All changes were below chance level of 50%.

Adding printed labels.

When printed labels were added to the line drawing design, the following results were obtained:

Table 7. Adding Printed Labels - Preschoolers

Choices:	Triad I	Triad II	Triad III
A most similar to T	30.77%	35.29%	41.18%
B most similar to T	76.47%	64.71%	58.82%

n = 17

For triad I and II roughly one third of the preschool participants decided that stimulus A was most similar to the target and two thirds judged stimulus B most similar to the target. In triad III 41.18% decided on A as the most similar stimulus and 58.82% found B the most similar stimulus. Triad III was also the triad with the most changes from stimulus A to B and stimulus B to A as a result of adding a printed label. In triad II 17.65% changed their mind and in triad I only 5.88%, which equals 1 change (Table 7). The amount of change after adding printed labels is below the chance level of 50% (Table8).

Table 8.Changes After Adding Printed Labels

	Triad I	Triad II	Triad III
Changes	5.88%	17.65%	23.53%

n = 17

Qualitatively, it can be added that only one of seventeen preschoolers verbalized concerns that he could not read the printed labels yet by stating: "But I can't read yet", and pointed to the labels.

Adding verbal and printed labels.

In the experimental condition where verbal and printed labels were added, the following results were recorded:

Table 9. Adding Verbal and Printed Labels -Preschoolers

Choices:	Triad I	Triad II	Triad III
A most similar to T	29.41%	29.41%	29.41%
B most similar to T	70.59%	70.59%	70.59%

n = 17

In all three triads approximately one-third decided to choose stimulus A and two thirds decided to choose stimulus B to be most similar to the target. However, the changes in each triad differed (Table 9).

Table 10. Changes After Adding Verbal and Printed Labels

	Triad I	Triad II	Triad III
Changes	11.77%	47.07%	47.07%

n = 17

Triads II and III had equal numbers of changes after adding a verbal and printed label to each the line drawing designs. In triad I only 2 participants (11.77%) chose a different stimulus after hearing and seeing the linguistic feature of each line drawing design. As displayed in Table 10, the percentages of change are close to chance level (50%) in triad II and III.

Summary.

Figure 2 provides a summary of all the changes in preschool participants when having to choose stimulus A or B without linguistic labels and in the event when linguistic labels were added to the line drawing designs in the form of a verbal label, printed label or verbal and printed label.

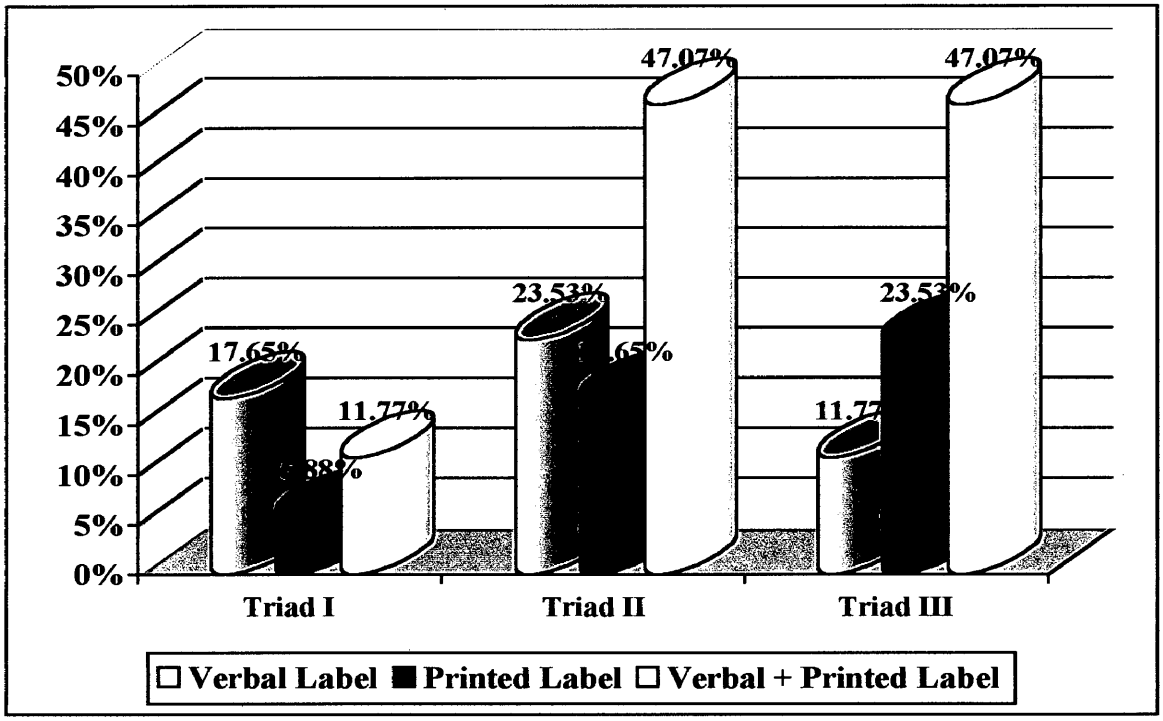


Figure 2. Preschoolers: Adding linguistic labels.
Percentages of change after adding verbal labels, printed labels, or verbal and printed labels.

In triad I most changes occurred when the verbal label was added to the line drawing designs. One stimulus was labeled /nami/, which rhymed with the target label /fami/. The other stimulus received the non-rhyming label /suna/. The label /nami/ shared all but one phoneme with the target label /fami/ and only differed in one phoneme by three phonological features: nasality, location, and voicing. The verbal label /suna/ only shared the vowel /a/ with the target label /fami/.

In triad II most changes occurred when verbal and printed labels were added to the line drawing designs. One stimulus was labeled /guga/, which rhymed with the target label /luga/. The other stimulus received the non-rhyming label /migu/. The label /guga/ shared all but one phoneme with the target label /luga/ and only differed in one phoneme by two phonological features: location and a plosive vs. a liquid. From a visual linguistic feature standpoint, the labels <guga> and <luga> shared all but one grapheme. They differed in the initial graphemes <g> and <l>. The other verbal and printed label <migu> only shared the vowel /u/ with the target label. From a visual linguistic features standpoint, the labels <luga> and <migu> shared fewer graphemes than <luga> and <guga>.

Adding the linguistic feature of each line drawing design only in the auditory modality revealed fewer changes (23.53%) than adding the linguistic feature in auditory and visual modality (47.07%), but more than adding the linguistic feature only in the visual modality (11.77%).

In triad III most changes occurred when the verbal and printed labels were added to the line drawing designs. One stimulus was labeled /kito/, which rhymed with the

target label /pito/. The other stimulus received the non-rhyming label /saki/. The label /kito/ shared all but one phoneme with the target label /pito/ and only differed in one phoneme by one phonological feature: location. From a visual linguistic feature standpoint, the labels <kito> and <pito> shared all but one grapheme. They differed in the initial graphemes <k> and <p>. The other verbal and printed label <saki> only shared the vowel /i/ with the target label. From a visual linguistic features standpoint, the labels <pito> and <saki> shared fewer graphemes than <kito> and <pito>.

The Effect of Adding Linguistic Labels - Adults

Adding verbal labels.

When verbal labels were added to the line drawing design and the verbal label of the target rhymes with one of the test stimuli, the following results were obtained:

Table 11. Adding Verbal Labels - Adults

Choices:	Triad I	Triad II	Triad III
A most similar to T	44.44%	44.44%	55.56%
B most similar to T	55.56%	55.56%	44.44%

n = 18

In all three triads the choices for stimulus A or B were almost evenly divided among adult participants. Since in the control condition, the majority of participants chose stimulus B (94.44% in triad I and II, 88.89% in triad III) as the most similar stimulus, almost half of the adults (50.00% in triad II and 55.56% in triad III) changed their decision on similarity in triad II and III when a verbal label was added (Table 12). In triad I the change is lower.

Table 12. Changes After Adding Verbal Labels

	Triad I	Triad II	Triad III
Changes	38.89%	50.00%	55.56%

n = 18

Adding printed labels.

When printed labels were added to line drawing designs, the following results were obtained:

Table 13. Adding Printed Labels - Adults

Choices:	Triad I	Triad II	Triad III
A most similar to T	27.78%	33.33%	33.33%
B most similar to T	72.22%	66.67%	66.67%

n = 18

Table 14 displays the amount of choices for stimulus A and B. In triad II and III the same number of participants picked stimulus A or B when a printed label was given. However, the amount of change from one stimulus to the other was higher in triad III (44.44%) compared to triad II (27.78%) (Table 14).

Table 14. Changes After Adding Printed Labels

	Triad I	Triad II	Triad III
Changes	33.33%	27.78%	44.44%

n = 18

Qualitatively, some adult participants expressed confusion at this point of the testing about the task. One woman asked:" Do you want me to go by the picture or the

words?". In this case the instruction was repeated the same way as the first time. The participant then responded: "Oh, you can't tell me."

Adding verbal and printed labels.

In the verbal and printed label condition, the following results were recorded:

Table 15. Adding Verbal and Printed Labels - Adults

Choices:	Triad I	Triad II	Triad III
A most similar to T	50.00%	38.89%	55.56%
B most similar to T	50.00%	61.11%	44.44%

n = 18

As table 15 displays, in triad I the number of participants who decided to choose stimulus A to be most similar to the target is the same as the number who picked stimulus B. In Triad II only seven adults (38.89%) picked stimulus A and 11 adults (61.11%) chose stimulus B. In triad III the numbers for stimulus A and B were nearly evenly divided. Table 16 provides the percentages of changes in the similarity judgment of adult participants when a verbal and printed label was added.

Table 16. Changes After Adding Verbal and Printed Labels

	Triad I	Triad II	Triad III
Changes	50.00%	33.33%	66.67%

n = 18

Summary.

Figure 3 provides a summary of the percentage of change within the adults' similarity judgments after linguistic labels were added to the line drawing designs in the form of a verbal label, printed label or verbal and printed label.

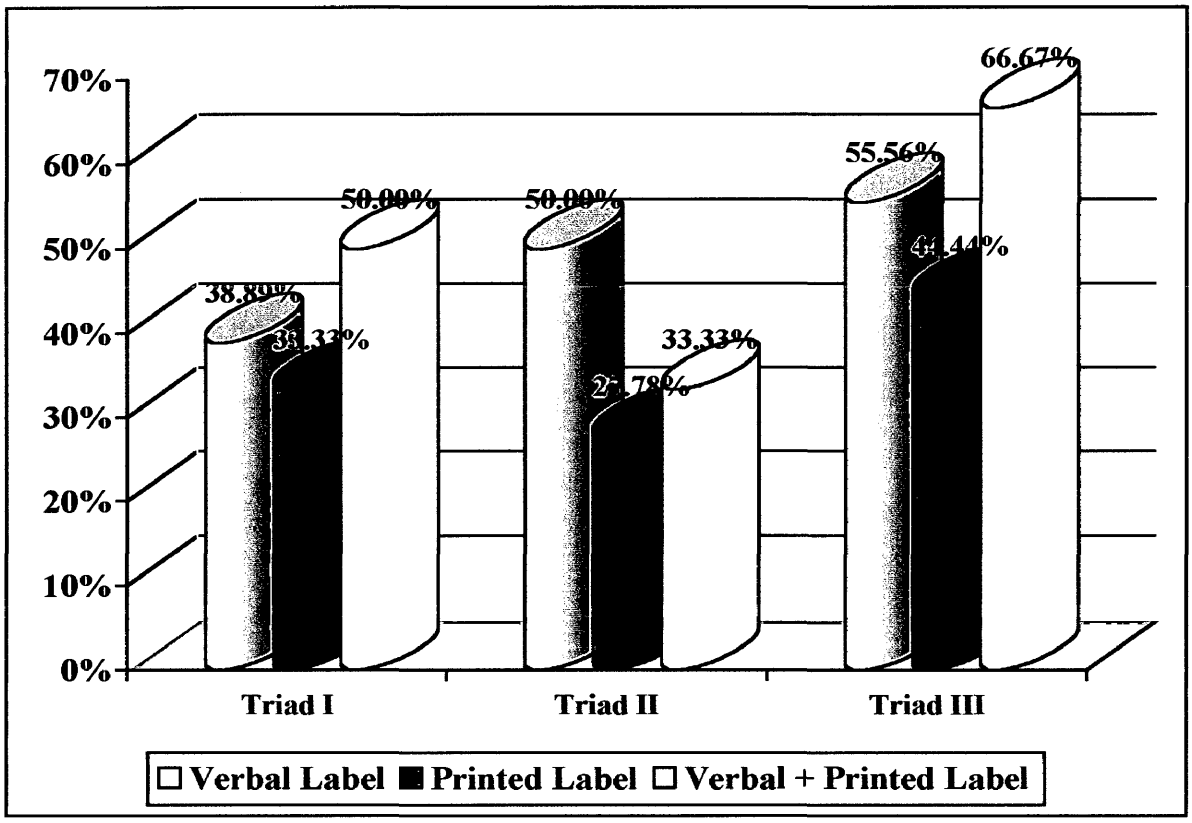


Figure 3. Adults: Adding linguistic labels.
Percentages of change after adding verbal labels, printed labels, and verbal and printed labels.

In triad I most changes occurred when the verbal and spoken label was added to the line drawing designs and the least amount of change was observed when a printed label was added. In triad II most changes occurred when the verbal label was added to the line drawing designs. However, when the label was provided in spoken and printed form the number of changes decreased from 50% in the spoken condition to 33.33% in the spoken and printed condition. The printed condition revealed the least amount of change in triad II.

In triad III more than half of the adults (55.56%) changed their decision when the verbal label was added to the line drawing designs. Even more changes (66.67%) were observed when the linguistic label was added in the spoken and printed form. The least number of changes occurred when labels were provided in the printed form (44.44%)

The Effect of Modality - Preschoolers

Verbal labels versus printed labels.

Testing the Null Hypotheses 1 to 3 revealed that changes were not equal across modalities. It can be inferred that the modality is a considerable factor affecting similarity judgment when adding linguistic features. Therefore, it appeared worthwhile to determine if there is a significant difference in the modality in which a linguistic feature is presented together with non-linguistic visual features. In other words, does the modality of the linguistic label have an impact on the similarity judgments?

In order to determine if there is a relationship between the amount of change in similarity judgments after adding verbal labels compared to verbal and printed labels the

percentages of change were calculated. A chi-square analysis was used for each condition in each triad.

Triad I.

Table 17. Changes After Adding Verbal Labels vs. Printed Labels - Triad I

	Verbal	Printed	Total
Changes	17.65%	5.88%	23.53%
No changes	82.35%	94.12%	176.47%
	100.00%	100.00%	200.00%

n = 17

Table 18. Chi-Square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Change verbal label	17.65%	11.77%	5.88%	34.57%	2.94
No change verbal label	82.35%	88.24%	-5.88%	34.57%	0.39
Change printed label	5.88%	11.77%	-5.88%	34.57%	2.94
No change printed label	94.12%	88.24%	5.88%	34.57%	0.39
					6.66

Alpha Level 0.01 → critical value 6.635 → 6.66 > 6.635 → reject Null Hypothesis

Triad II.

Table 19. Changes After Adding Verbal Labels vs. Printed Labels - Triad II

	Verbal	Printed	Total
Changes	23.53%	17.65%	41.18%
No changes	76.47%	82.35%	158.82%
	100.00%	100.00%	200.00%

n = 17

Table 20. Chi-Square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Change verbal label	23.53%	20.59%	2.94%	8.64%	0.42
No change verbal label	76.47%	79.41%	-2.94%	8.64%	0.11
Change printed label	17.65%	20.59%	-2.94%	8.64%	0.42
No change printed label	82.35%	79.41%	2.94%	8.64%	0.11
					1.06

Alpha Level 0.05 → critical value 3.841 → 1.06 < 3.841 → accept Null Hypothesis

Triad III.

Table 21. Changes After Adding Verbal Labels vs. Printed Labels - Triad III

	Verbal	Printed	Total
Changes	11.77%	23.53%	35.30%
No changes	88.23%	76.47%	164.70%
	100.00%	100.00%	200.00%

n = 17

Table 22 Chi-Square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Change verbal label	11.77%	17.65%	-5.88%	34.57%	1.96
No change verbal label	88.23%	82.35%	5.88%	34.57%	0.42
Change printed label	23.53%	17.65%	5.88%	34.57%	1.96
No change printed label	76.47%	82.35%	-5.88%	34.57%	0.42
					4.76

Alpha Level 0.05 → critical value 3.841 → 4.76 > 3.841 → reject Null Hypothesis

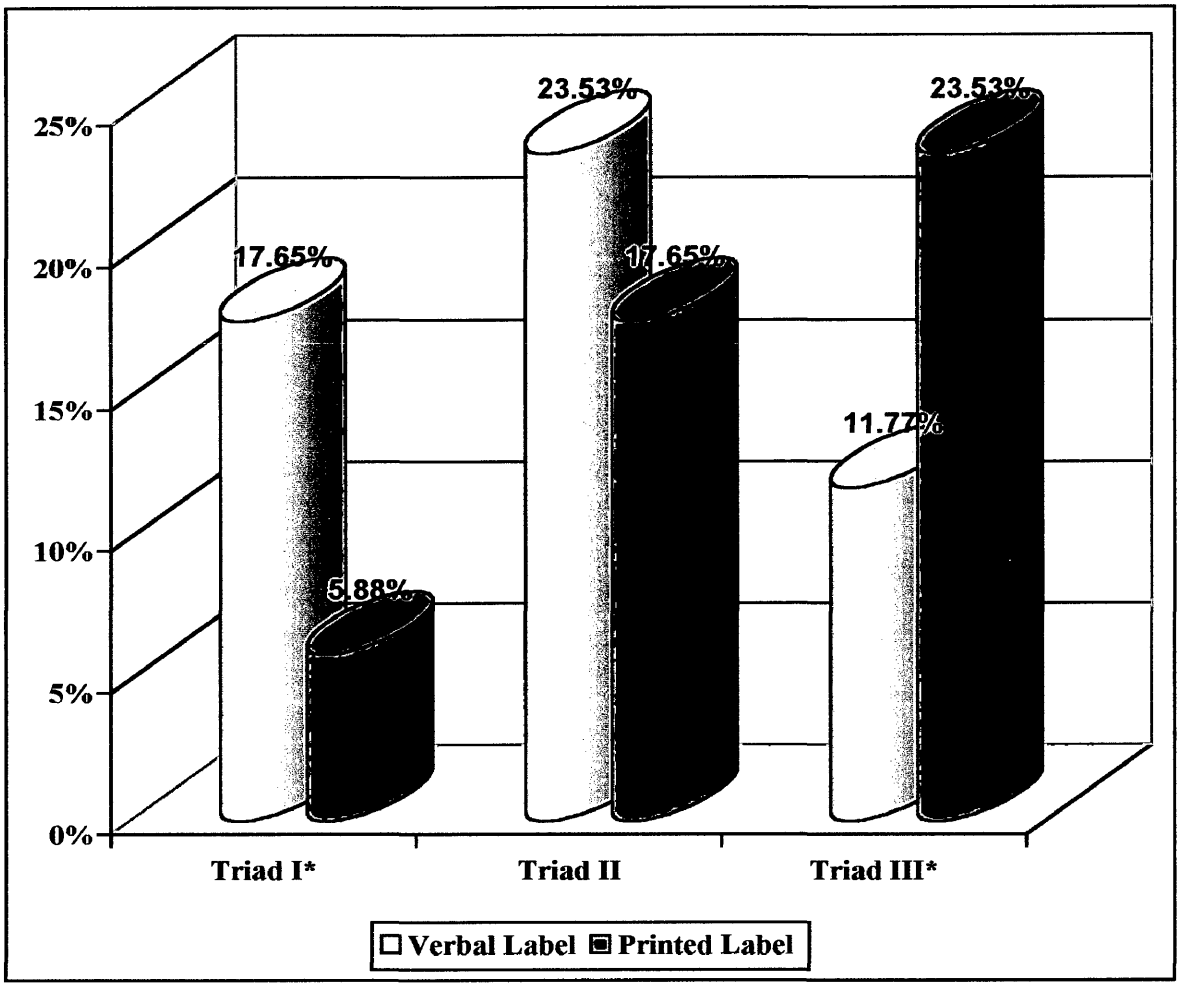


Figure 4. Preschoolers: Verbal versus printed labels.
Percentages of change after adding verbal labels and after adding printed labels.
* = significant relationship between changes in choice and modality of label.

The observed frequencies for changes in each triad and the experimental conditions can be found in Tables 17, 19, and 21. A chi-square test was used to identify if there was a relationship between changes of choice and modality of linguistic feature. In Triad I and III the relationship was found to be statistically significant at an alpha level of $p \leq .01$ for the amount of changes in the preschool participants' choices for stimulus A or B and the modality of the linguistic label (Table 18; Table 22).

In triad I preschoolers displayed significantly more changes after a verbal label was added ($\chi^2(1, N = 17) = 6.66, p \leq . . 01$). As reported in Table 18, preschoolers were more likely to change their mind about the similarity of stimulus A or B when a linguistic label was added in the form of a spoken word compared to a printed word.

In triad II more changes occurred after the verbal label was given compared to the printed label. However, these changes did not reach significance.

Preschoolers displayed significantly fewer changes after a verbal label was added in triad III ($\chi^2(1, N = 17) = 4.76, p \leq .05$). As reported in Table 21, preschool participants were more likely to change their minds about which stimulus was most similar to the target when a printed label (visual modality) was provided compared to a verbal label (auditory modality).

Across all three triads there were two outcomes of significance. In triad I hearing the labels was related to the change in similarity judgment and in triad III seeing the label was related to the change in similarity judgment (Figure 4).

Verbal labels versus verbal and printed labels.

In order to determine if there is a relationship between the amount of change in choice for stimulus A or B after adding verbal labels compared to verbal and printed labels the percentages of change were calculated. A chi-square analysis was used to determine the relationship of changes in choice and modality of linguistic feature in each triad.

Triad I.

Table 23. Changes After Adding Verbal Labels vs. Verbal and Printed Labels- Triad I

	Verbal	Verbal + Printed	Total
Changes	17.65%	11.77%	29.42%
Changes no changes	82.35%	88.23%	170.58%
	100.00%	100.00%	200.00%

n = 17

Table 24. Chi-Square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Change verbal label	17.65%	14.71%	2.94%	8.64%	0.59
No change verbal label	82.35%	85.29%	-2.94%	8.64%	0.10
Change verbal + printed label	11.77%	14.71%	-2.94%	8.64%	0.59
No change verbal + printed label	88.23%	85.29%	2.94%	8.64%	0.10
					1.38

Alpha Level 0.05 → critical value 3.841 → 1.38 < 3.841 → accept Null Hypothesis

Triad II.

Table 25. Changes After Adding Verb. Labels vs. Verb. and Printed Labels - Triad II

	Verbal	Verbal + Printed	Total
Changes	23.53%	47.07%	70.60%
No changes	76.47%	52.93%	129.40%
	100.00%	100.00%	200.00%

n = 17

Table 26. Chi-Square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Change verbal labels	23.53%	35.30%	-11.77%	138.53%	3.92
No change verbal labels	76.47%	64.71%	11.77%	138.53%	2.14
Change verbal + printed labels	47.07%	35.30%	11.77%	138.53%	3.92
No change verbal + printed labels	52.93%	64.71%	-11.77%	138.53%	2.14
					12.12

Alpha Level 0.01 → critical value 6.635 → 12.12 > 6.635 → reject Null Hypothesis

Triad III.

Table 27. Changes After Adding Verb. Labels vs. Verb. and Printed Labels - Triad III

	Verbal	Verbal + Printed	Total
Changes	11.77%	47.07%	58.84%
No changes	88.23%	52.93%	141.16%
	100.00%	100.00%	200.00%

n = 17

Table 28. Chi-Square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Change verbal labels	11.77%	29.42%	-17.65%	311.52%	10.59
No change verbal labels	88.23%	70.58%	17.65%	311.52%	4.41
Change verbal + printed labels	47.07%	29.42%	17.65%	311.52%	10.59
No change verbal + printed labels	52.93%	70.58%	-17.65%	311.52%	4.41
					30.00

Alpha Level 0.01 → critical value 6.635 → 30.00 > 6.635 → reject Null Hypothesis

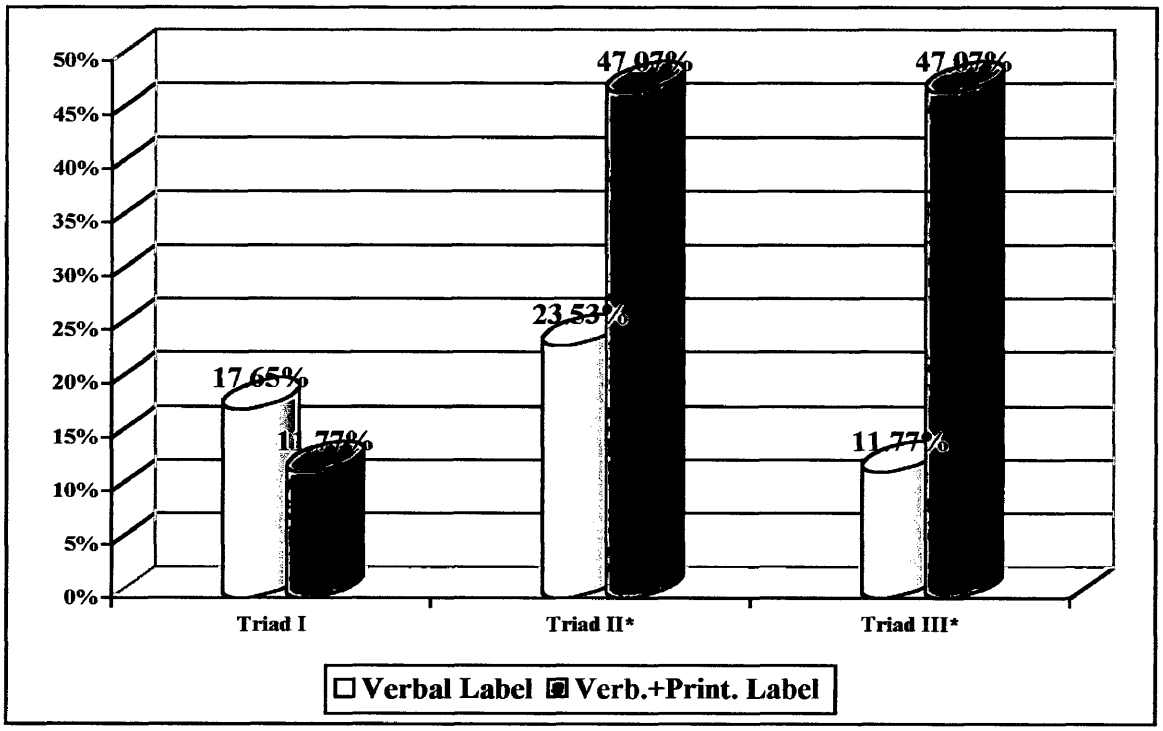


Figure 5. Preschoolers: Verbal labels versus verbal and printed labels.
Percentages of change of choice after adding verbal labels and after adding a verbal and printed labels.
* = significant relationship between changes in choice and modality of label.

The observed frequencies for changes in each triad and the experimental conditions can be found in Tables 23, 25 and 27. A chi-square test was used to identify if there was a relationship between changes of choice and modality of linguistic feature. In Triad II and III the relationship was found to be significant at an alpha level of $p \leq .01$ for the amount of change in the preschool participants' choices for stimulus A or B and the modality of the linguistic label (Table 26, Table 28).

In triad I more changes occurred after the verbal label was given compared to the verbal and printed label. However, the changes to the other stimulus after verbal or verbal and printed labels were provided did not reach statistical significance.

In triad II preschoolers displayed significantly more changes after verbal labels were added ($\chi^2(1, N = 17) = 12.12, p \leq .01$). As reported in Table 26, preschoolers were more likely to change their mind about the similarity of stimulus A or B when a linguistic label was added in verbal and printed form compared to just verbal form.

Preschoolers displayed significantly fewer changes after verbal labels were added in triad III ($\chi^2(1, N = 17) = 30.00, p \leq .01$). As reported in Table 28, preschool participants were much more likely to change their minds about which stimulus was most similar to the target when verbal and printed labels were provided compared to just verbal labels.

Across all three triads there were two outcomes of significance. In triads II and III hearing and seeing the labels were significantly related to the amount of change in similarity judgment (Figure 5).

Printed labels versus verbal and printed labels.

In order to determine if there is a relationship between the amount of changes in choice for stimulus A or B after adding printed labels compared to verbal and printed labels the percentages of change were calculated. A chi-square analysis was used in each triad.

Triad I.

Table 29. Changes After Adding Printed Labels vs. Verb. and Printed Labels - Triad I

	Printed	Verbal + Printed	Total
Changes	5.88%	11.77%	17.65%
No changes	94.12%	88.23%	182.35%
	100.00%	100.00%	200.00%

n = 17

Table 30. Chi-Square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Change printed label	5.88%	8.82%	-2.94%	8.64%	0.98
No change printed label	94.12%	91.18%	2.94%	8.64%	0.09
Change spoken + printed label	11.77%	8.82%	2.94%	8.64%	0.98
No change spoken + printed label	88.23%	91.18%	-2.94%	8.64%	0.09
					2.14

Alpha Level 0.01 → critical value 6.635 → 2.14 < 6.635 → accept Null Hypothesis

Triad II.

Table 31. Changes After Adding Printed Labels vs. Verb. and Printed Labels - Triad II

	Printed	Verbal + Printed	Total
Changes	17.65%	47.07%	64.72%
No changes	82.35%	52.93%	135.28%
	100.00%	100.00%	200.00%

n =17

Table 32. Chi-Square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Change printed label	17.65%	32.36%	-14.71%	216.38%	6.69
No change printed label	82.35%	67.64%	14.71%	216.38%	3.20
Change spoken + printed label	47.07%	32.36%	14.71%	216.38%	6.69
No change spoken + printed label	52.93%	67.64%	-14.71%	216.38%	3.20
					19.78

Alpha Level 0.01 → critical value 6.635 → 19.78 > 6.635 → reject Null Hypothesis

Triad III.

Table 33. Changes After Adding Print. Labels vs. Verb. and Print. Labels - Triad III

	Printed	Verbal + Printed	Total
Changes	23.53%	47.07%	70.60%
No changes	76.47%	52.93%	129.40%
	100.00%	100.00%	200.00%

n = 17

Table 34. Chi-Square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Change printed label	23.53%	35.30%	-11.77%	138.53%	3.92
No change printed label	76.47%	64.70%	11.77%	138.53%	2.14
Change spoken + printed label	47.07%	35.30%	11.77%	138.53%	3.92
No change spoken + printed label	52.93%	64.70%	-11.77%	138.53%	2.14
					12.12

Alpha Level 0.01 → critical value 6.635 → 12.12 > 6.635 → reject Null Hypothesis

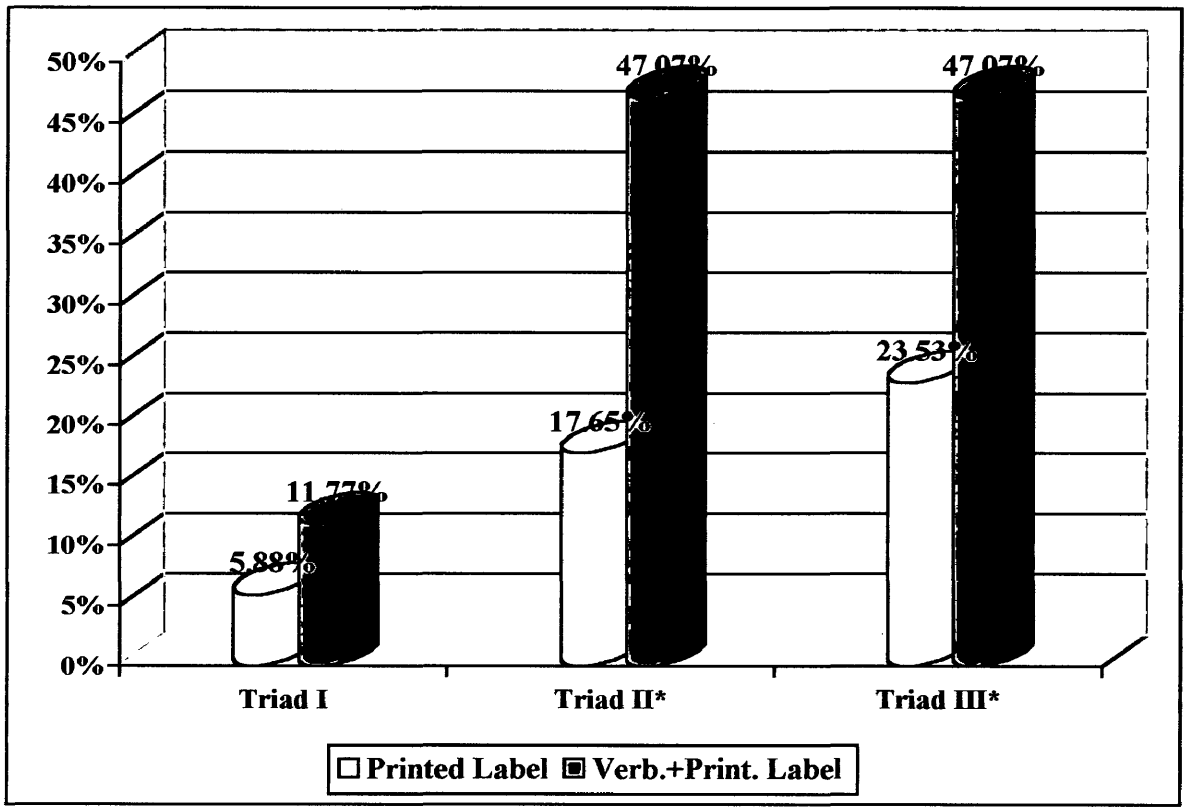


Figure 6. Preschoolers: Printed labels versus verbal and printed labels.
Percentages of change after adding printed labels and after adding verbal and printed labels.
* = significant relationship between changes in choice and modality of label.

The observed frequencies for changes in each triad and the experimental conditions can be found in Tables 29, 31, and 33. A chi-square test was used to identify if there was a relationship between changes of choice and modality of linguistic feature. In Triad II and III the relationship was found to be significant at an alpha level of $p \leq .01$ for the amount of changes in the preschool participants' choices for stimulus A or B and the modality of the linguistic label (Table 32; Table 34).

In triad I more changes occurred after the verbal and printed label was given compared to just the printed label. However, the changes to the other stimulus after printed or verbal and printed labels were added to the line drawing designs did not reach a significance.

In triad II preschoolers displayed significantly more changes after a linguistic label was added in the form of a spoken and printed word ($\chi^2(1, N = 17) = 19.78, p \leq .01$). As reported in Table 32, preschoolers were more likely to change their mind about the similarity of stimulus A or B when a linguistic label was added in spoken and printed form compared to just printed form.

Preschoolers displayed significantly fewer changes after a printed label (visual modality) was added in triad III ($\chi^2(1, N = 17) = 12.12, p \leq .01$). As reported in Table 34, preschool participants were much more likely to change their minds about the similarity of one of the test stimuli to the target when they could hear and see the linguistic feature.

Across all three triads there were two outcomes of significance. In triads II and III hearing and seeing the labels were significantly related to the change in similarity judgment (Figure 6).

Summary.

Table 35. Summary: The Effect of Modality - Preschoolers

	Triad I	Triad II	Triad III
Verbal – Printed	$\chi^2 = 6.66$ Reject Null Hypothesis	$\chi^2 = 1.06$ Accept Null Hypothesis	$\chi^2 = 4.76$ Reject Null Hypothesis
Verbal – Verbal + Printed	$\chi^2 = 1.38$ Accept Null Hypothesis	$\chi^2 = 12.12$ Reject Null Hypothesis	$\chi^2 = 30.00$ Reject Null Hypothesis
Printed – Verbal + Printed Label	$\chi^2 = 2.14$ Accept Null Hypothesis	$\chi^2 = 19.78$ Reject Null Hypothesis	$\chi^2 = 12.12$ Reject Null Hypothesis

In triad I the verbal label was significantly related to the similarity judgment of preschoolers when compared with a printed label. In triad II the verbal and printed labels were significantly related to the similarity judgment when compared with verbal labels and printed labels. In triad III the verbal and printed labels were significantly related to the amount of change in similarity judgments when compared to verbal labels and to printed labels.

The Effect of Modality Within Each Age Group - Adults

Verbal labels versus printed labels.

In order to determine if there is a relationship between the change in choice for stimulus A or B in similarity judgments of line drawing designs and the modality in which a linguistic label is added (verbal labels compared to printed labels) the percentages of change were calculated. A chi-square analysis was used for each condition in each triad.

Triad I.

Table 36. Changes After Adding Verbal Labels vs. Printed Labels - Triad I

	Verbal	Printed	Total
Changes	38.89%	33.33%	72.22%
Changes no changes	61.11%	66.67%	127.78%
	100.00%	100.00%	200.00%

n = 18

Table 37. Chi-Square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Change verbal label	38.89%	36.11%	2.78%	7.73%	0.21
No change verbal label	61.11%	63.89%	-2.78%	7.73%	0.12
Change printed label	33.33%	36.11%	-2.78%	7.73%	0.21
No change printed label	61.11%	63.89%	2.78%	7.73%	0.12
					0.66

Alpha Level 0.05 → critical value 3.841 → 0.66 < 3.841 → accept Null Hypothesis

Triad II.

Table 38. Changes After Adding Verbal Labels vs. Printed Labels - Triad II

	Verbal	Printed	Total
Changes	50.00%	27.78%	77.78%
Changes no changes	50.00%	72.22%	122.22%
	100.00%	100.00%	200.00%

n = 18

Table 39. Chi-Square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Change verbal label	50.00%	38.89%	11.11%	123.43%	3.17
No change verbal label	50.00%	61.11%	-11.11%	123.43%	2.02
Change printed label	27.78%	38.89%	-11.11%	123.43%	3.17
No change printed label	72.22%	61.11%	11.11%	123.43%	2.02
					10.38

Alpha Level 0.01 → critical value 6.635 → 10.38 > 6.635 → reject Null Hypothesis

Triad III.

Table 40. Changes After Adding Verbal Labels vs. Printed Labels - Triad III

	Verbal	Printed	Total
Changes	55.56%	44.44%	100.00%
Changes no changes	44.44%	55.56%	100.00%
	100.00%	100.00%	200.00%

n = 18

Table 41. Chi-Square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Change verbal label	55.56%	50.00%	5.56%	30.91%	0.62
No change verbal label	44.44%	50.00%	-5.56%	30.91%	0.62
Change printed label	44.44%	50.00%	-5.56%	30.91%	0.62
No change printed label	55.56%	50.00%	5.56%	30.91%	0.62
					2.48

Alpha Level 0.05 → critical value 3.841 → 2.48 < 3.841 → accept Null Hypothesis

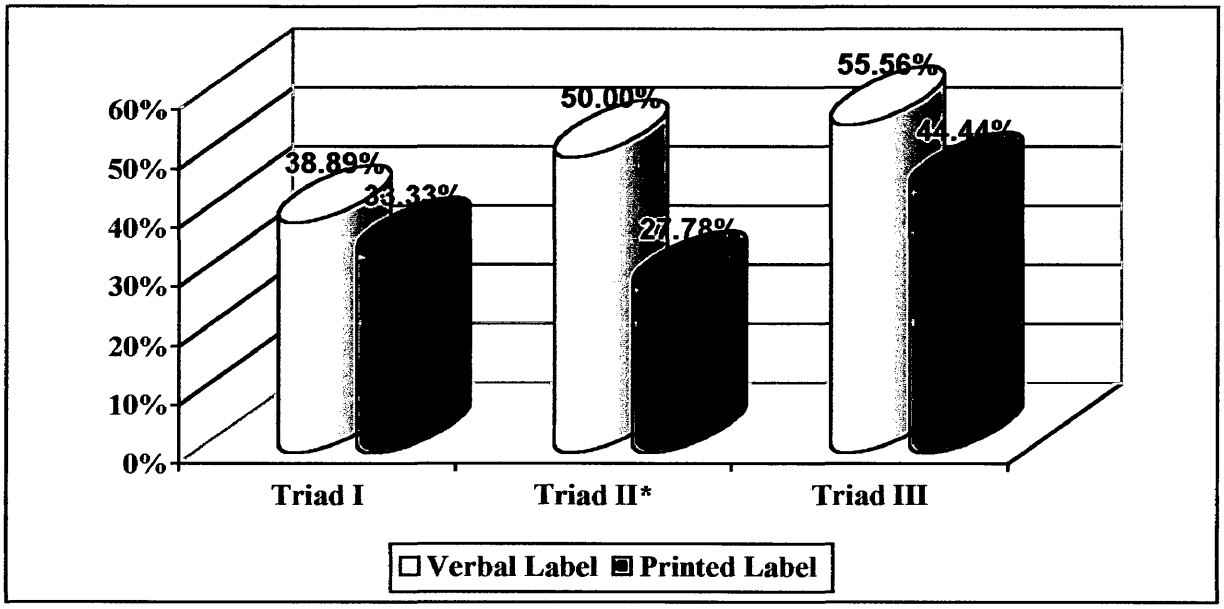


Figure 7. Adults: Verbal labels versus printed labels.
Percentages of change in choice after adding verbal labels and after adding printed labels.
* = significant relationship between changes in choice and modality of label.

The observed frequencies for changes in each triad and the experimental conditions can be found in Tables 36, 38, and 40. A chi-square test was used to identify if there was a relationship between changes of choice and modality of linguistic feature. Only in triad II the relationship was found to be significant at an alpha level of $p \leq .01$ for the amount of changes in the adults' choices for stimulus A or B and the modality of the linguistic label (Table 39).

In triad II adults displayed significantly more changes after a linguistic label was added in auditory modality ($\chi^2(1, N = 18) = 10.38, p \leq .01$). As reported in Tables 39, the adult participants were more likely to change their mind about the similarity of stimulus A or B when a linguistic label was added in the form of a spoken word compared to a printed word.

In triad I and III more changes occurred after the verbal label was given compared to the printed label. However, these changes did not reach significance (Figure 7).

Verbal label versus verbal and printed label.

In order to determine if there is a relationship between the amount of change in choice for stimulus A or B after adding verbal labels compared to adding verbal and printed labels the percentages of change were calculated. A chi-square analysis was used in each triad.

Triad I.

Table 42. Changes After Adding Verb. Labels vs. Verb. and Printed Labels - Triad I

	Verbal	Verbal + Printed	Total
Changes	38.89%	50.00%	88.89%
Changes no changes	61.11%	50.00%	111.11%
	100.00%	100.00%	200.00%

n = 18

Table 43. Chi-Square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Change verbal label	38.89%	44.45%	-5.56%	30.91%	0.70
No change verbal label	61.11%	55.56%	5.55%	30.80%	0.55
Change verbal + printed label	50.00%	44.45%	5.55%	30.80%	0.69
No change verbal + printed label	50.00%	55.56%	-5.56%	30.91%	0.56
					2.5

Alpha Level 0.05 → critical value 3.841 → 2.5 < 3.841 → accept Null Hypothesis

Triad II.

Table 44. Changes After Adding Verb. Labels vs. Verb. and Printed Labels - Triad II

	Verbal	Verbal + Printed	Total
Changes	50.00%	33.33%	83.33%
Changes no changes	50.00%	66.67%	116.67%
	100.00%	100.00%	200.00%

n = 18

Table 45. Chi-Square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Change verbal labels	50.00%	41.67%	8.33%	69.39%	1.67
No change verbal labels	50.00%	58.34%	-8.34%	69.56%	1.19
Change verbal + printed labels	33.33%	41.67%	-8.34%	69.56%	1.67
No change verbal + printed labels	66.67%	58.34%	8.33%	69.39%	1.19
					5.72

Alpha Level 0.01 → critical value 6.635 → 5.72 < 6.635 → accept Null Hypothesis

Triad III.

Table 46. Changes After Adding Verb. Labels vs. Verb. and Printed Labels - Triad III

	Verbal	Verbal + Printed	Total
Changes	55.56%	66.67%	122.23%
Changes no changes	44.44%	33.33%	77.77%
	100.00%	100.00%	200.00%

n = 18

Table 47. Chi-square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Change verbal labels	55.56%	61.12%	-5.56%	30.91%	0.51
No change verbal labels	44.44%	38.89%	5.55%	30.80%	0.79
Change verbal + printed labels	66.67%	61.12%	5.55%	30.91%	0.51
No change verbal + printed labels	33.33%	38.89%	-5.56%	30.80%	0.79
					2.60

Alpha Level 0.05 → critical value 3.841 → 2.60 < 3.841 → accept Null Hypothesis

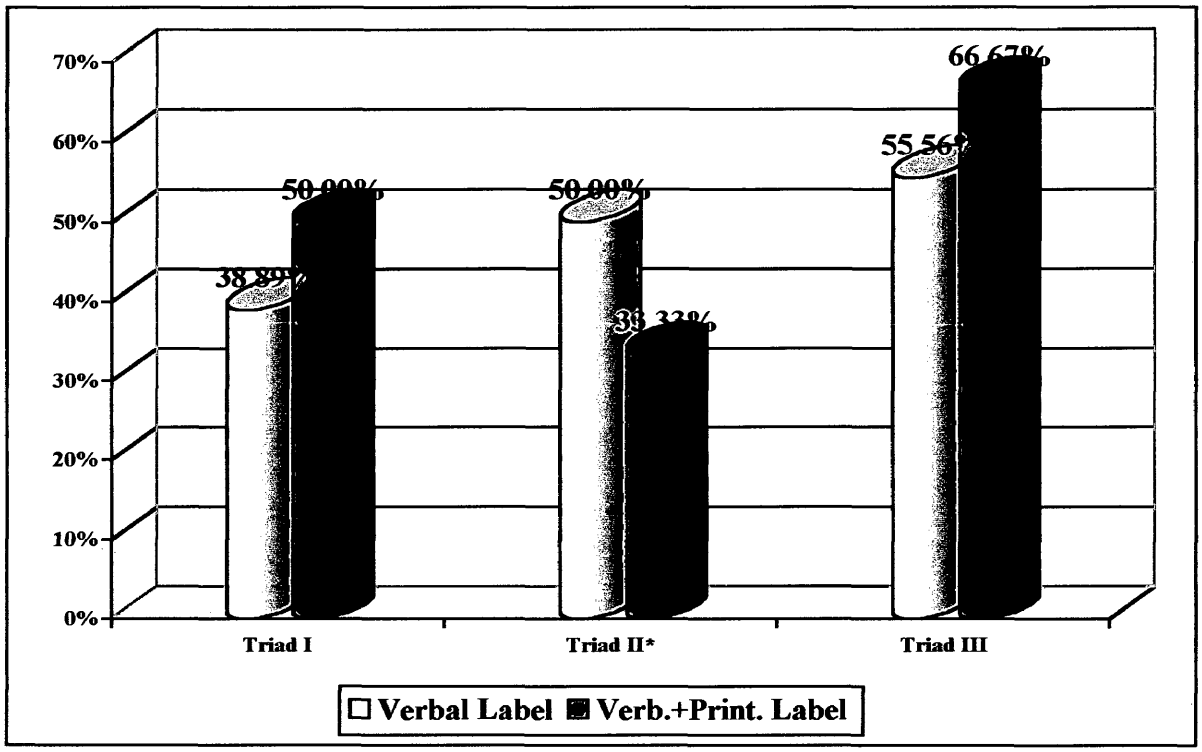


Figure 8. Adults: Verbal labels versus verbal and printed labels.
Percentages of change in choice after adding verbal labels and after adding verbal and printed labels to the line drawing design.
* = significant relationship between changes in choice and modality of label.

The observed frequencies for changes in each triad and the experimental conditions can be found in Tables 42, 44, and 46. A chi-square test was used to identify if there was a relationship between changes of choice and modality of linguistic feature. In triad II the relationship was found to be significant at an alpha level of $p \leq .05$ for the amount of change in the preschool participants' choices for stimulus A or B and the modality of the linguistic label (Table 45).

In triad I more changes occurred after the verbal and printed label was given compared to the verbal label. However, the changes were not significant. In triad II adults displayed significantly more changes after a linguistic label was added in the auditory modality ($\chi^2(1, N = 17) = 5.72, p \leq .05$). As reported in Table 45, adults were more likely to change their mind about the similarity of stimulus A or B when a linguistic label was added in spoken form compared to spoken and printed form.

In triad III more changes occurred after the spoken and printed word was given compared to just the spoken word. As in triad I, the changes did not reach significance (Figure 8).

Printed label versus verbal and printed label.

In order to determine if there is a relationship between the amount of changes in choice for stimulus A or B after adding printed labels compared to adding verbal and printed labels the percentages of change were calculated. A chi-square analysis was used in each triad.

Triad I.

Table 48. Changes After Adding Printed Labels vs. Verb. and Printed Labels - Triad I

	Printed	Verbal + Printed	Total
Changes	33.33%	50.00%	83.33%
Changes no changes	66.67%	50.00%	116.67%
	100.00%	100.00%	200.00%

n = 18

Table 49. Chi-Square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Change printed label	33.33%	41.67%	-8.34%	69.56%	1.69
No change printed label	66.67%	58.34%	8.33%	69.39%	1.19
Change spoken + printed label	50.00%	41.67%	8.33%	69.39%	1.67
No change spoken + printed label	50.00%	58.34%	-8.34%	69.56%	1.19
					5.74

Alpha Level 0.05 → critical value 3.841 → 5.74 > 3.841 → reject Null Hypothesis

Triad II.

Table 50. Changes After Adding Printed Labels vs. Verb. and Printed Labels - Triad II

	Printed	Verbal + Printed	Total
Changes	27.78%	33.33%	61.11%
Changes no changes	72.22%	66.67%	138.89%
	100.00%	100.00%	200.00%

n = 18

Table 51. Chi-square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Change printed label	27.78%	30.56%	-2.78%	7.73%	0.25
No change printed label	72.22%	69.45%	2.77%	7.67%	0.11
Change spoken + printed label	33.33%	30.56%	2.77%	7.67%	0.25
No change spoken + printed label	66.67%	69.45%	-2.78%	7.73%	0.11
					0.72

Alpha Level 0.05 → critical value 3.841 → 0.72 < 3.841 → accept Null Hypothesis

Triad III.

Table 52. Changes After Adding Print. Labels vs. Verb. and Print. Labels - Triad III

	Printed	Verbal + Printed	Total
Changes	44.44%	66.67%	111.11%
Changes no changes	55.56%	33.33%	88.89%
	100.00%	100.00%	200.00%

n = 18

Table 53. Chi-square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Change printed label	44.44%	55.56%	-11.12%	123.65%	2.23
No change printed label	55.56%	44.45%	11.11%	123.43%	2.78
Change spoken + printed label	66.67%	55.56%	11.11%	123.43%	2.23
No change spoken + printed label	33.33%	44.45%	-11.12%	123.65%	2.78
					10.02

Alpha Level 0.01 → critical value 6.635 → 10.02 > 6.635 → reject Null Hypothesis

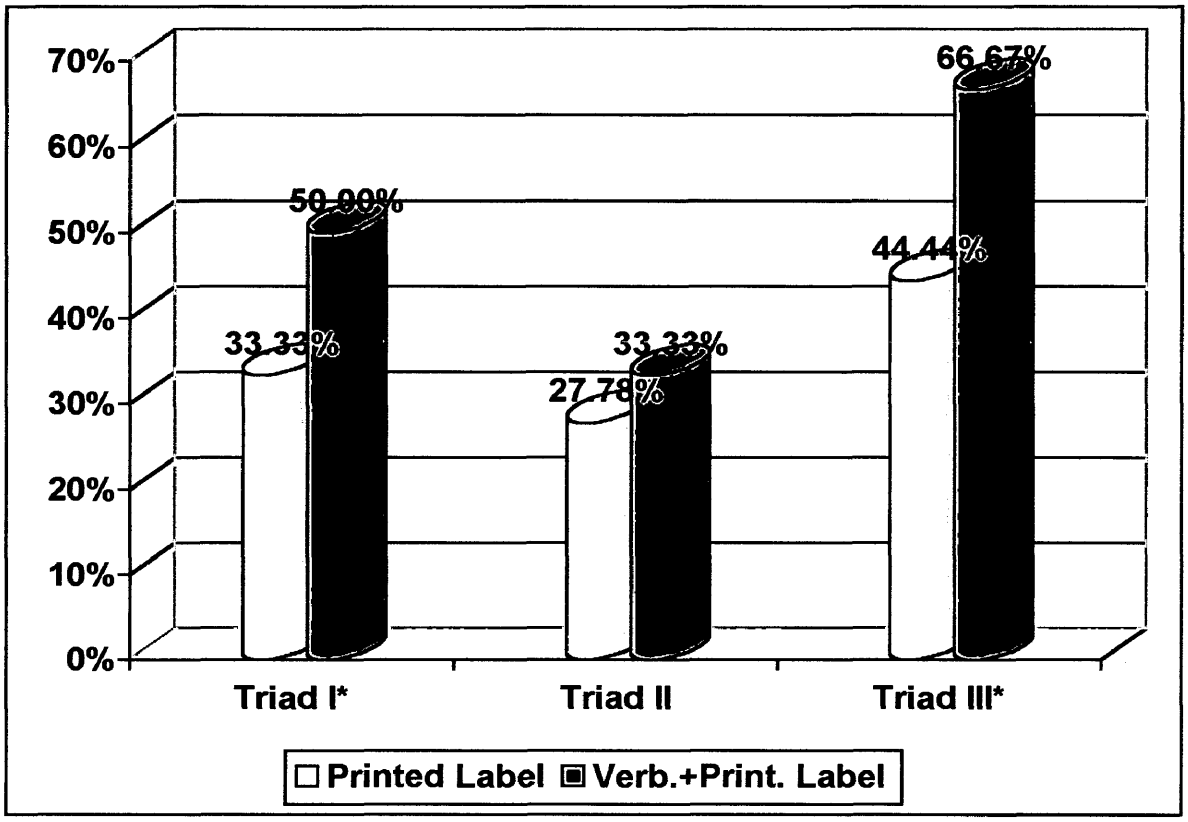


Figure 9. Adults: Printed labels versus verbal and printed labels.
Percentages of change in choice after adding printed labels and after adding printed and verbal labels.
* = significant relationship between changes in choice and modality of label.

The observed frequencies for changes in each triad and the experimental conditions can be found in Tables 48, 50, and 52. A chi-square test was used to identify if there was a relationship between changes of choice and modality of linguistic feature. In Triad I and III the relationship was found to be significant at an alpha level of $p \leq .05$ (and $p \leq .01$ in triad III) for the amount of changes in the preschool participants' choices for stimulus A or B and the modality of the linguistic label (Table 49; Table 53).

In triad I adult participants displayed significantly more changes after verbal and printed labels were added ($\chi^2(1, N = 18) = 5.74$, $p \leq .05$). As reported in Table 49, adults were more likely to change their mind about the similarity of stimulus A or B when verbal and printed labels were added compared to just in the printed form.

In triad II more changes occurred after the verbal and printed label was added compared to just the printed label. However, the changes to the other stimulus after printed or verbal and printed labels were added to the line drawing designs did not reach a significance.

Adults displayed significantly more changes after verbal and printed labels were added in triad III ($\chi^2(1, N = 17) = 10.02$, $p \leq .01$). As reported in Table 53, adult participants were much more likely to change their minds about the similarity of one of the test stimuli to the target when they could hear and see the linguistic feature.

In triad I changes at chance level (50%) were observed after adding verbal and printed labels. In triad III changes above change level (66.67%) were observed after adding verbal and printed labels compared to the no label condition (Figure 9).

Summary.

Table 54. Summary: The Effect of Modality - Adults

	Triad I	Triad II	Triad III
Verbal – Printed	$\chi^2 = 0.66$	$\chi^2 = 10.38$	$\chi^2 = 2.48$
	Accept Null Hypothesis	Reject Null Hypothesis	Accept Null Hypothesis
Verbal – Verbal + Printed	$\chi^2 = 2.5$	$\chi^2 = 5.72$	$\chi^2 = 2.60$
	Accept Null Hypothesis	Reject Null Hypothesis	Accept Null Hypothesis
Printed – Verbal + Printed Label	$\chi^2 = 5.74$	$\chi^2 = 0.72$	$\chi^2 = 10.02$
	Reject Null Hypothesis	Accept Null Hypothesis	Reject Null Hypothesis

In triad I there was a relationship between adding verbal and printed labels and adding just printed labels on the similarity judgment of adults. Adults are more likely to change their mind when they hear and read the label of a line drawing instead of just reading a printed label. In triad II adding verbal labels significantly raised the likelihood of a change in the choice for stimulus A or B versus printed labels. Also adding verbal labels was significant to increase the likelihood of a change in the similarity judgment in adults when compared with verbal and printed labels. In triad III verbal and printed labels was significantly related to the change in similarity judgments in adults when comparing it to printed labels.

The Effect of Age: Comparing the Control Condition

In order to determine if there is a relationship between age and similarity judgments of line drawing designs the percentages of choices for stimulus A and stimulus

B were calculated. A chi-square analysis was used to determine the relationship between age and similarity judgment for each triad.

Triad I.

Table 55. Results of Control Condition: Adults vs. Preschoolers – Triad I

Choices:	Preschoolers (n=17)	Adults (n=18)	Total
A most similar to T	17.65% (3 of 17)	05.56% (1 of 18)	23.21%
B most similar to T	82.35%	94.44%	176.79%
	100.00%	100.00%	200.00%

Table 56. Chi-square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Preschoolers stimulus A	17.65%	11.61%	6.04%	36.48%	3.14
Preschoolers stimulus B	82.35%	88.40%	-6.05%	36.60%	0.41
Adults stimulus A	5.56%	11.61%	-6.05%	36.60%	3.15
Adults stimulus B	94.44%	88.40%	6.04%	36.48%	0.41
					7.11

Alpha Level 0.01 → critical value 6.635 → 7.11 > 6.635 → reject Null Hypothesis

Triad II.

Table 57. Results of Control Condition: Adults vs. Preschoolers – Triad II

Choices:	Preschoolers (n=17)	Adults (n=18)	Total
A most similar to T	29.41% (6 of 17)	05.56% (1 of 18)	34.97%
B most similar to T	70.59%	94.44%	165.03%
	100.00%	100.00%	200.00%

Table 58. Chi-square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Preschoolers stimulus A	29.41%	17.49%	11.92%	142.09%	8.12
Preschoolers stimulus B	70.59%	82.52%	-11.93%	142.33%	1.73
Adults stimulus A	5.56%	17.49%	-11.93%	142.33%	8.14
Adults stimulus B	94.44%	82.52%	11.92%	142.09%	1.72
					19.71

Alpha Level 0.01 → critical value 6.635 → 19.71 > 6.635 → reject Null Hypothesis

Triad III.

Table 59. Results of Control Condition: Adults vs. Preschoolers – Triad III

Choices:	Preschoolers (n=17)	Adults (n=18)	Total
A most similar to T	52.93% (9 of 17)	11.11% (2 of 18)	64.04%
B most similar to T	47.07%	88.89%	135.96%
	100.00%	100.00%	200.00%

Table 60. Chi-square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Preschoolers stimulus A	52.93%	32.02%	20.91%	437.23%	13.66
Preschoolers stimulus B	47.07%	67.98%	-20.91%	437.23%	6.43
Adults stimulus A	11.11%	32.02%	-20.91%	437.23%	13.66
Adults stimulus B	88.89%	67.98%	20.91%	437.23%	6.43
					40.18

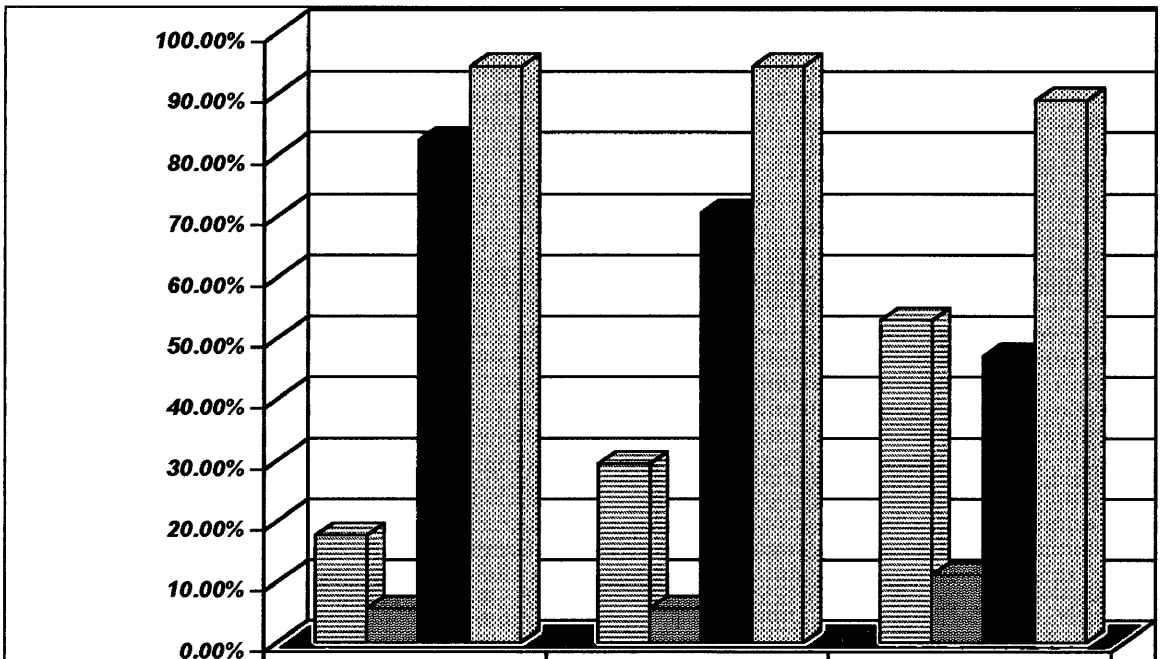
Alpha Level 0.01 → critical value 6.635 → 40.18 > 6.635 → reject Null Hypothesis

The percentages of observed frequencies for selection of stimulus A and stimulus B in preschoolers and adults in each triad can be found in Tables 55, 57, and 59. A chi-square test was used to determine if there was a relationship between the age of the participant and the selection of stimulus A or B as being most similar to the target. Tables 56, 58, and 60 display the chi-square calculations. In all three triads there was a significant relationship ($p \leq .01$) for the percentages of change in similarity judgments between preschool participants and adults. That means that in all three triads the age of participants has an impact on the decisions in similarity judgments.

In triad I, 17 out of 18 (94.44%) adults judged stimulus B as more similar to the target than stimulus A, but only 11 out of 17 (70.59%) of the preschoolers decided on stimulus B ($\chi^2(1, N = 35) = 7.11, p \leq .01$). As reported in Table 56, preschoolers were more likely to select stimulus A as more similar to the target than adults.

In triad II the relationship of age and similarity judgment was even more contrasting ($\chi^2(1, N = 35) = 19.71, p \leq .01$). As reported in Table 58, preschool participants were much more likely to judge stimulus A as being more similar to the target compared to the adults.

In triad III the relationship of age and similarity judgment was most contrasting ($\chi^2(1, N = 35) = 40.18, p \leq .01$). As reported in Table 60, preschool participants were much more likely to judge stimulus A as being more similar to the target compared to the adults.



	Triad I*	Triad II*	Triad III*
stim. A preschoolers	17.65%	29.41%	52.94%
stim. A adults	5.56%	5.56%	11.11%
stim. B preschoolers	82.35%	70.59%	47.06%
stim. B adults	94.44%	94.44%	88.89%

Figure 10. Preschoolers versus adults: Control condition.
Percentages of observed frequencies for selection of A and B.
* = significant relationship between age and selection of stimulus A or B.

Comparing the Effect of Modalities and Age Groups

Sloutsky and Lo (1999) and Sloutsky and Napolitano (2003) provided evidence that additional features in the auditory modality are more likely to draw the preschoolers' attention rather than the adults' attention. However, in this study change was observed in similarity judgments across all experimental conditions in both age groups. In fact, there was a higher percentage of change in similarity judgments observed in the adult participants than in the preschool participants across all experimental conditions. Hence, further data analysis is warranted to determine if there is a relationship between the age group and the amount of change in similarity judgment when adding linguistic labels to line drawing designs. Also, a comparison between the different experimental conditions and between age groups will provide valuable information about the impact of linguistic features in different modalities. Therefore, the Null Hypotheses 8-13 are going to be addressed next.

Adding verbal labels.

In order to determine if there is a relationship between age and similarity judgments of line drawing designs when verbal labels were added, the amount of change in similarity judgments from the control condition to the experimental condition was calculated. A chi-square analysis was used to determine the relationship between age and similarity judgment for each triad.

Triad I.

Table 61. Results After Adding Verbal Labels: Adults vs. Preschoolers – Triad I

Choices:	Preschoolers (n=17)	Adults (n=18)	Total
Change:	17.65%	38.89	56.54%
No change:	82.35%	61.11%	143.46%
	100.00%	100.00%	200.00%

Table 62. Chi-Square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Preschoolers change	17.65%	28.27%	-10.62%	112.78%	3.99
Preschoolers no change	82.35%	71.73%	10.62%	112.78%	1.57
Adults change	38.89%	28.27%	10.62%	112.78%	3.99
Adults no change	61.11%	71.73%	-10.62%	112.78%	1.57
					11.12

Alpha Level 0.01 → critical value 6.635 → 11.12 > 6.635 → reject Null Hypothesis

Triad II.

Table 63a. Results After Adding Verbal Labels: Adults vs. Preschoolers – Triad II

Choices:	Preschoolers (n=17)	Adults (n=18)	Total
Change	23.53%	50.00%	73.53%
No change	76.47%	50.00%	126.47%
	100.00%	100.00%	200.00%

Table 64. Chi-square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Preschoolers change	23.53%	36.77%	-13.24%	175.30%	4.77
Preschoolers no change	76.47%	63.24%	13.23%	175.03%	2.77
Adults change	50.00%	36.77%	13.23%	175.03%	4.77
Adults no change	50.00%	63.24%	-13.24%	175.30%	2.77
					15.08

Alpha Level 0.01 → critical value 6.635 → 15.08 > 6.635 → reject Null Hypothesis

Triad III.

Table 65. Results After Adding Verbal Labels: Adults vs. Preschoolers – Triad III

Choices:	Preschoolers (n=17)	Adults (n=18)	Total
Change	11.77%	32.02%	43.79%
No change	88.23%	67.98%	156.21%
	100.00%	100.00%	200.00%

Table 66. Chi-square Analysis

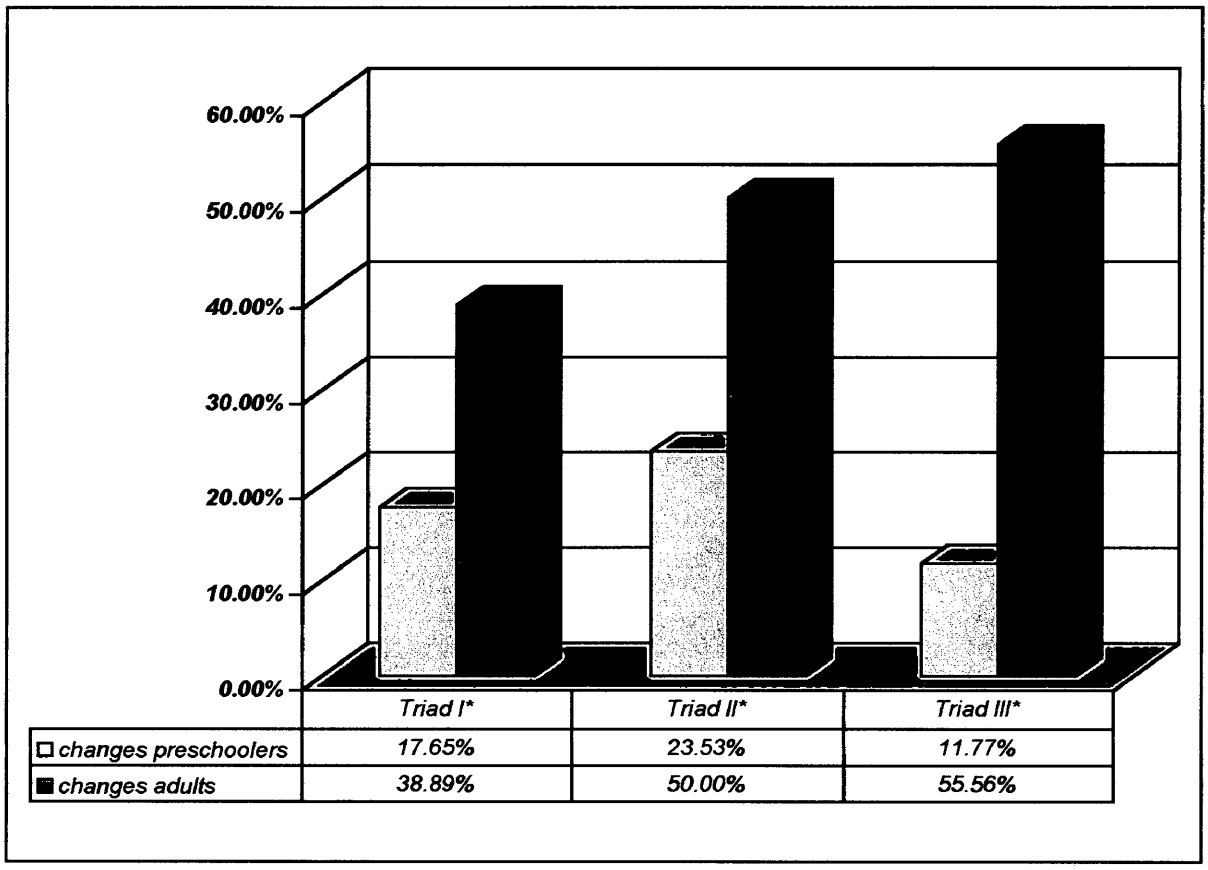
	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Preschoolers change	11.77%	21.90%	-10.13%	102.62%	4.69
Preschoolers no change	88.23%	78.11%	10.12%	102.41%	1.31
Adults change	55.56%	78.11%	-22.55%	508.50%	6.51
Adults no change	44.44%	21.90%	22.54%	508.05%	23.20
					35.71

Alpha Level 0.01 → critical value 6.635 → 35.71 > 6.635 → reject Null Hypothesis

The percentages of observed frequencies for changes in selecting stimulus A or B after adding verbal labels can be found in Tables 61, 63, and 65. A chi-square test was used to determine if there was a relationship between the age of the participant and the amount of change in selection of stimulus A or B as being most similar to the target. Tables 62, 64, and 66 display the chi-square calculations. In all three triads there was a significant relationship ($p \leq .01$) for the percentages of change in similarity judgments between preschool participants and adults. That means that in all three triads the age of participants has an impact on the how often decisions will change after adding verbal labels to line drawing designs.

In triad III the relationship of age and change in decisions was most contrasting ($\chi^2(1, N = 35) = 35.71, p \leq .01$). As reported in Table 66, adult participants were much more likely to change their decision about the similarity of stimulus A or B to the target compared to the preschoolers.

In triad II the relationship of age and similarity judgment was slightly more significant ($\chi^2(1, N = 35) = 15.08, p \leq .01$) than for triad I ($\chi^2(1, N = 35) = 11.12, p \leq .01$) . As reported in Table 64 and Table 66, adults were much more likely to change their mind on similarity judgment when provided with verbal labels for line drawing designs compared to preschoolers.



	Triad I*	Triad II*	Triad III*
changes preschoolers	17.65%	23.53%	11.77%
changes adults	38.89%	50.00%	55.56%

Figure 11. Preschoolers versus adults: Adding verbal labels.
Percentages of observed frequencies for changes after adding verbal labels.
* = significant relationship between age and selection of stimulus A or B.

Adding printed labels.

In order to determine if there is a relationship between age and similarity judgments of line drawing designs when printed labels were added, the amount of change in similarity judgments from the control condition to the experimental condition was calculated. A chi-square analysis was used to determine the relationship between age and similarity judgment.

Triad I.

Table 67. Results After Adding Printed Labels: Adults vs. Preschoolers – Triad I

Choices:	Preschoolers (n=17)	Adults (n=18)	Total
Change:	05.88%	33.33%	39.21%
No change:	94.12%	66.67%	160.79%
	100.00%	100.00%	200.00%

Table 68. Chi-square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Preschoolers change	5.88%	19.61%	-13.73%	188.51%	9.61
Preschoolers no change	94.12%	80.40%	13.72%	188.24%	2.34
Adults change	33.33%	19.61%	13.72%	188.24%	9.60
Adults no change	66.67%	80.40%	-13.73%	188.51%	2.34
					23.89

Alpha Level 0.01 → critical value 6.635 → 23.89 > 6.635 → reject Null Hypothesis

Triad II.

Table 69. Results After Adding Printed Labels – Triad II

Choices:	Preschoolers (n=17)	Adults (n=18)	Total
Change	17.65%	27.78%	45.43%
No change	82.35%	72.22%	154.57%
	100.00%	100.00%	200.00%

Table 70. Chi-Square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Preschoolers change	17.65%	22.72%	-5.07%	25.71%	1.13
Preschoolers no change	82.35%	77.29%	5.06%	25.60%	0.33
Adults change	27.78%	22.72%	5.06%	25.60%	1.13
Adults no change	72.22%	77.29%	-5.07%	25.71%	0.33
					2.92

Alpha Level 0.05 → critical value 3.841 → 2.92 < 3.841 → accept Null Hypothesis

Triad III.

Table 71. Results After Adding Printed Labels: Adults vs. Preschoolers – Triad III

Choices:	Preschoolers (n=17)	Adults (n=18)	Total
Change	23.53%	44.44%	67.97%
No change	76.47%	55.56%	132.03%
	100.00%	100.00%	200.00%

Table 72. Chi-Square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Preschoolers change	23.53%	33.99%	-10.49%	110.04%	3.24
Preschoolers no change	76.47%	66.02%	10.45%	109.20%	1.65
Adults change	44.44%	33.99%	10.45%	109.20%	3.21
Adults no change	55.56%	66.02%	-10.46%	109.42%	1.66
					9.76

Alpha Level 0.01 → critical value 6.635 → 9.76 > 6.635 → reject Null Hypothesis

The percentages of observed frequencies for changes in selecting stimulus A or B after adding printed labels can be found in Tables 67, 69, and 71. A chi-square test was used to determine if there was a relationship between the age of the participant and the amount of change in selection of stimulus A or B as being most similar to the target. Tables 68, 70, and 72 display the chi-square calculations. In triad I and III a statistically significant relationship for the percentages of change in similarity judgments between preschool participants and adults. That means that in these two triads the age of participants has an impact on the amount of change in decisions after adding printed labels to line drawing designs.

In triad I the relationship of age and change in decisions was most contrasting ($\chi^2(1, N = 35) = 23.89, p \leq .01$). As reported in Table 68, adult participants were much

more likely to change their decision about the similarity of stimulus A or B to the target when labels were provided in print compared to the preschoolers.

In triad II the relationship of age and similarity judgment was not significant ($\chi^2(1, \underline{N} = 35) = 2.92, p \leq .01$). However, as reported in Table 70, adults were more likely to change their mind on similarity judgment when provided with printed labels for line drawing designs compared to preschoolers.

In triad I the relationship of age and change in decisions was significant ($\chi^2(1, N = 35) = 9.76, p \leq .01$). As in triad I, adult participants were much more likely to change their decision about the similarity of stimulus A or B to the target when labels were provided in print compared to the preschoolers (Table 72).

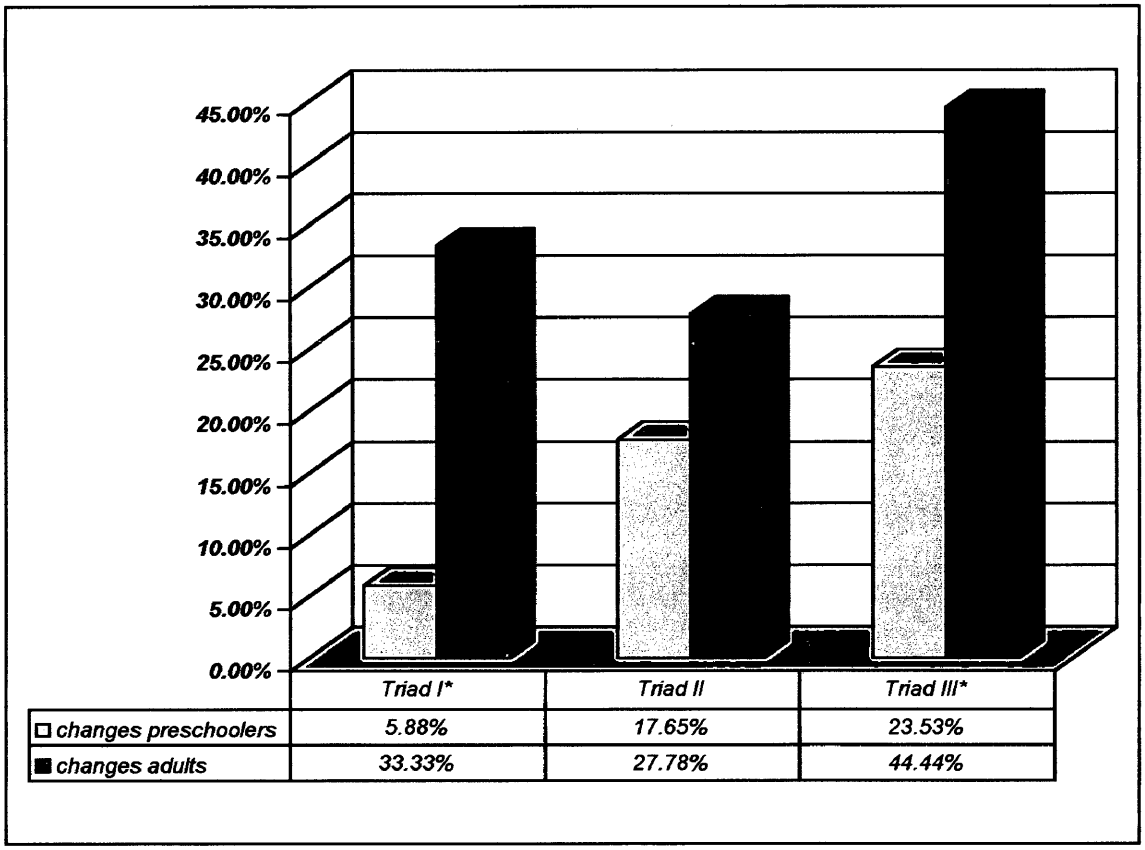


Figure 12. Preschoolers versus adults: Adding printed labels.
Percentages of observed frequencies for changes in selecting A and B after adding printed labels.
* = significant relationship between age and selection of stimulus A or B.

Adding verbal and printed labels.

In order to determine if there is a relationship between age and similarity judgments of line drawing designs when verbal and printed labels were added, the amount of change in similarity judgments from the control condition to the experimental condition was calculated. A chi-square analysis was used to determine the relationship between age and similarity judgment.

Triad I.

Table 73. Results After Adding Verbal and Printed Labels: Adults vs. Preschoolers – Triad I

Choices:	Preschoolers (n=17)	Adults (n=18)	Total
Change:	11.77%	50.00%	61.77%
No change:	88.23%	50.00%	138.23%
	100.00%	100.00%	200.00%

Table 74. Chi-square analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Preschoolers change	11.77%	30.89%	-19.12%	365.57%	11.84
Preschoolers no change	88.23%	69.12%	19.11%	365.19%	5.28
Adults change	50.00%	30.89%	19.11%	365.19%	11.82
Adults no change	50.00%	69.12%	-19.12%	365.57%	5.29
					33.87

Alpha Level 0.01 → critical value 6.635 → 33.87 > 6.635 → reject Null Hypothesis

Triad II.

Table 75. Results After Adding Verbal and Printed Labels: Adults vs. Preschoolers – Triad II

Choices:	Preschoolers (n=17)	Adults (n=18)	Total
Change	47.07%	33.33%	80.40%
No change	52.93%	66.67%	119.60%
	100.00%	100.00%	200.00%

Table 76. Chi-square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Preschoolers change	47.07%	40.20%	6.87%	47.20%	1.17
Preschoolers no change	52.93%	59.80%	6.87%	47.20%	0.79
Adults change	33.33%	40.20%	-6.87%	47.20%	1.17
Adults no change	66.67%	59.80%	-6.87%	47.20%	0.79
					3.92

Alpha Level 0.01 → critical value 6.635 → 3.92 < 6.635 → accept Null Hypothesis

Triad III.

Table 77. Results After Adding Verbal and Printed Labels: Adults vs. Preschoolers Triad III

Choices:	Preschoolers (n=17)	Adults (n=18)	Total
Change	47.07%	66.67%	113.74%
No change	52.93%	33.33%	88.26%
	100.00%	100.00%	200.00%

Table 78. Chi-square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Preschoolers change	47.07%	56.87%	-9.80%	96.04%	1.69
Preschoolers no change	52.93%	43.13%	9.80%	96.04%	2.23
Adults change	66.67%	56.87%	9.80%	96.04%	1.69
Adults no change	33.33%	43.13%	-9.80%	96.04%	2.23
					7.84

Alpha Level 0.01 → critical value 6.635 → 7.84 > 6.635 → reject Null Hypothesis

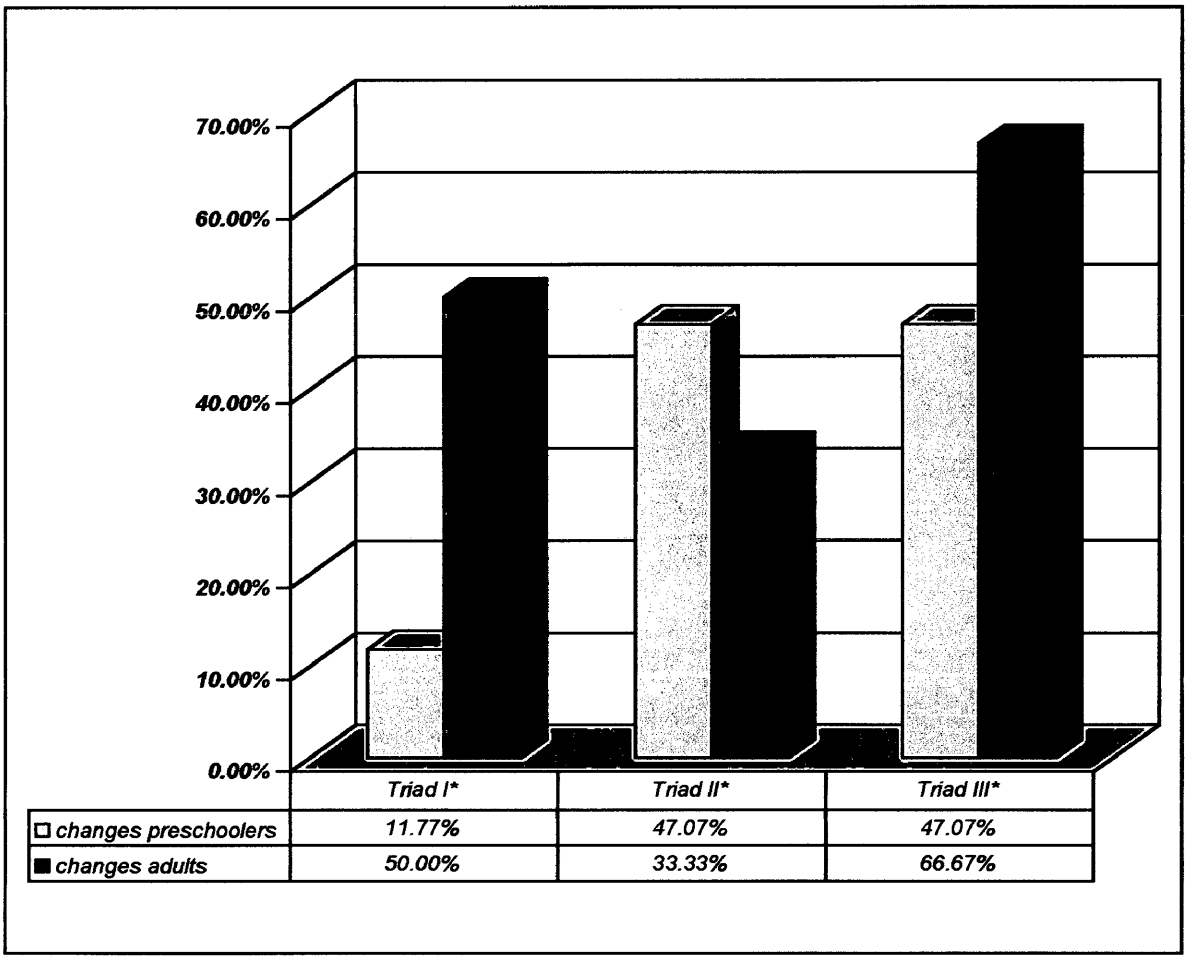
The percentages of observed frequencies for changes in selecting stimulus A or B after adding verbal and printed labels can be found in Tables 73, 75 and 77. A chi-square test was used to determine if there was a relationship between the age of the participant and the amount of change in selection of stimulus A or B as being most similar to the target. Tables 74, 76 and 78 display the chi-square calculations. In all three triads a

significant relationship was found for the percentages of change in similarity judgments between preschool participants and adults. That means that in all three triads the age of participants has an impact on the amount of changed decisions after adding verbal and printed labels to line drawing designs.

In triad I the relationship of age and change in decisions was most contrasting ($\chi^2(1, N = 35) = 33.87, p \leq .01$). As reported in Table 74, adult participants were much more likely to change their decision about the similarity of stimulus A or B to the target when labels were provided in auditory and in print compared to the preschoolers.

In triad II the relationship of age and similarity judgment was significant for $\chi^2(1, N = 35) = 3.92, p \leq .05$, but not for $\chi^2 (1, N = 35) = 3.92, p \leq .01$). As reported in Table 76, adults were more likely to change their mind on similarity judgment when provided with verbal and printed labels for line drawing designs compared to preschoolers.

In triad III the relationship of age and change in decisions was significant $\chi^2(1, N = 35) = 7.84, p \leq .01$). Adult participants were much more likely to change their decision about the similarity of stimulus A or B to the target when labels were provided in auditory and in print compared to the preschoolers (Table 78).



	Triad I*	Triad II*	Triad III*
□ changes preschoolers	11.77%	47.07%	47.07%
■ changes adults	50.00%	33.33%	66.67%

Figure 13. Preschoolers versus adults: Adding verbal and printed labels.
Percentages of observed frequencies for changes in selection A and B after adding verbal and printed labels.
* = significant relationship between age and selection of stimulus A or B.

Adding Verbal Labels versus Printed Labels

The results of testing the Null Hypotheses 8 to 10 revealed the existence of a relationship between the amount of changes after adding a linguistic feature and the age of participants. In this study more adults demonstrated changes in their judgment compared to preschoolers. Sloutsky and Lo (1999) and Sloutsky and Napolitano (2003) argued that the impact of a label is modality specific. In their study young children demonstrated a preference for the auditory modality. In this study, most changes occurred after adding verbal and printed labels. Especially adult participants appeared to welcome the verbal and printed labels to base their decision on. Therefore, further analysis to determine if there is a relationship between the modality of the label and the amount of change in similarity judgments between the two age groups offered valuable insights. The amount of change in similarity judgments from one experimental condition to another experimental condition in both age groups was calculated. A chi-square analysis was used to determine the relationship between age and similarity judgment. Therefore, Null Hypotheses 11-13 will be tested next.

Triad I.

Table 79. Results After Adding Verbal Labels and Printed Labels: Adults vs. Preschoolers Triad I

Choices:	Verbal Label Preschooler	Verbal Label Adult	Printed Label Preschoolers	Printed Labels Adults	Total
Change:	17.65%	38.89%	05.88%	33.33%	95.75%
No Change:	82.35%	61.11%	94.12%	66.67%	304.25%
	100.00%	100.00%	100.00%	100.00%	400.00%

Table 80. Chi-square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Preschoolers change verbal	17.65%	23.94%	-6.29%	39.56%	1.65
Preschoolers no change verbal	82.35%	76.06%	6.29%	39.56%	0.52
Adults change verbal	38.89%	23.94%	14.95%	223.50%	9.34
Adults no change verbal	61.11%	76.06%	-14.95%	223.50%	2.94
Preschoolers change printed	5.88%	23.94%	-18.06%	326.16%	13.62
Preschoolers no change printed	94.12%	76.06%	18.06%	326.16%	4.28
Adults change printed	33.33%	23.94%	9.39%	88.17%	3.68
Adults no change printed	66.67%	76.06%	-9.39%	88.17%	1.16
					37.19

Alpha Level 0.01 → critical value 11.341 → 37.19 > 11.341 → reject Null Hypothesis

Triad II.

Table 81. Results After Adding Verbal Labels and Printed Labels: Adults vs. Preschoolers Triad II

Choices:	Verbal Label Preschoolers	Verbal Label Adult	Printed Label Preschoolers	Printed Labels Adults	Total
Change:	23.53%	50.00%	17.65%	27.78%	118.96%
No Change:	76.47%	50.00%	82.35%	72.22%	281.04%
	100.00%	100.00%	100.00%	100.00%	400.00%

Table 82. Chi-square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Preschoolers change verbal	23.53%	29.74%	-6.21%	38.56%	1.29
Preschoolers no change verbal	76.47%	70.26%	6.21%	38.56%	0.55
Adults change verbal	50.00%	29.74%	20.26%	410.47%	13.80
Adults no change verbal	50.00%	70.26%	-20.26%	410.47%	5.84
Preschoolers change printed	17.65%	29.74%	-12.09%	146.17%	4.92
Preschoolers no change printed	82.35%	70.26%	12.09%	146.17%	2.08
Adults change printed	27.78%	29.74%	-1.96%	3.84%	0.13
Adults no change printed	72.22%	70.26%	1.99%	3.84%	0.06
					28.67

Alpha Level 0.01 → critical value 11.341→ 28.67 > 11.341→ reject Null Hypothesis

Triad III.

Table 83. Results After Adding Verbal Labels and Printed Labels: Adults vs. Preschoolers – Triad III

Choices:	Verbal Label Preschoolers	Verbal Label Adult	Printed Label Preschoolers	Printed Labels Adults	Total
Change:	11.77%	55.56%	23.53%	44.44%	135.30%
No Change:	88.23%	44.44%	76.47%	55.56%	254.70%
	100.00%	100.00%	100.00%	100.00%	400.00%

Table 84. Chi-square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Preschoolers change verbal	23.53%	33.83%	-10.30%	106.09%	3.14
Preschoolers no change verbal	76.47%	66.18%	10.30%	106.09%	1.60
Adults change verbal	50.00%	33.83%	16.17%	261.47%	6.40
Adults no change verbal	50.00%	66.18%	-16.18%	261.79%	3.96
Preschoolers change printed	17.65%	33.83%	-16.18%	261.79%	7.74
Preschoolers no change printed	82.35%	66.18%	16.17%	261.47%	3.95
Adults change printed	27.78%	33.83%	-6.05%	36.60%	1.08
Adults no change printed	72.22%	66.18%	6.04%	36.48%	0.55
					28.42

Alpha Level 0.01 → critical value 11.341 → 28.42 > 11.341→ reject Null Hypothesis

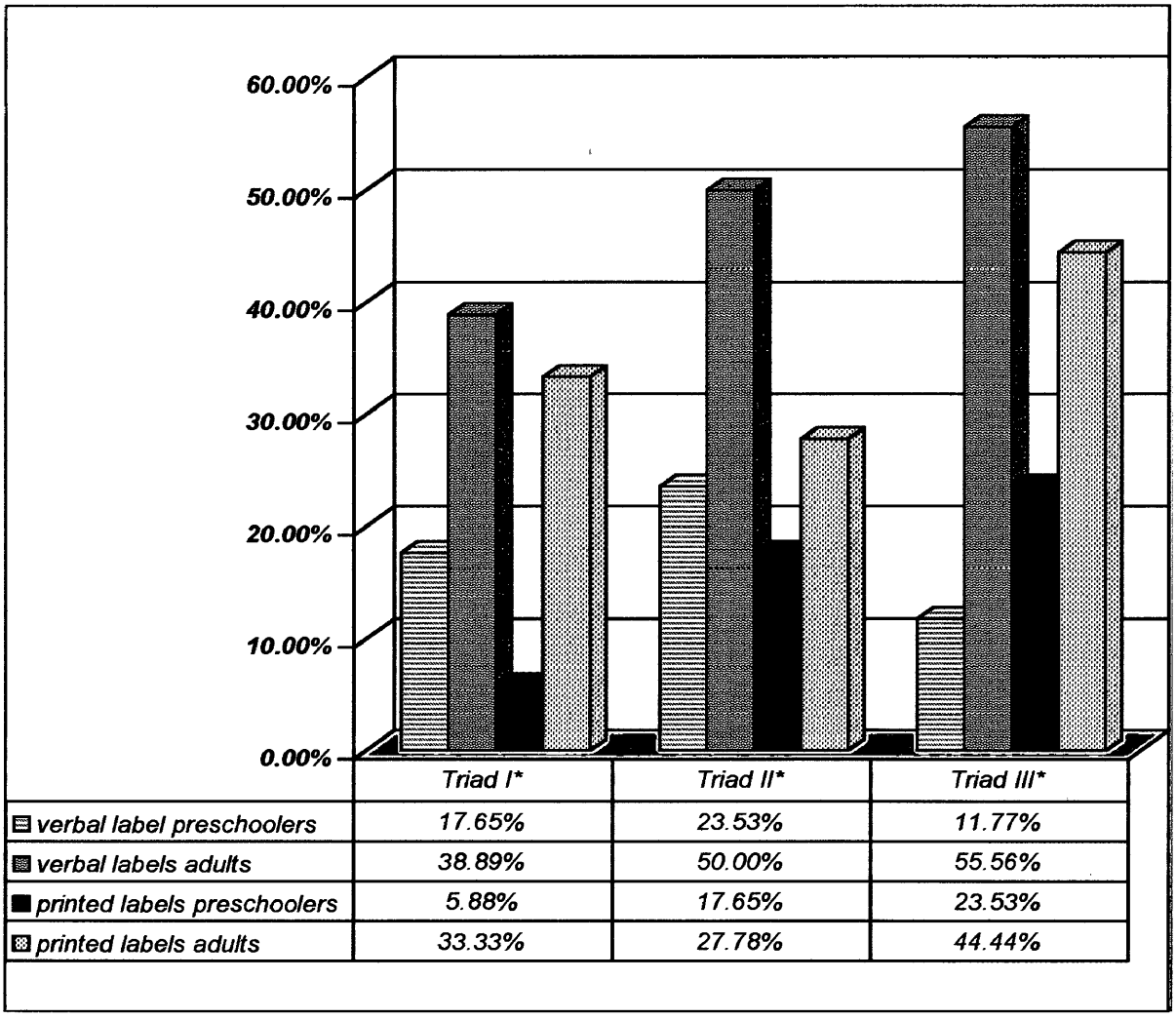
The percentages of observed frequencies for changes in selecting stimulus A or B after adding verbal labels can be found in Tables 79, 81 and 83. A chi-square test was used to determine if there was an effect of the age and the modality of linguistic labels on the amount of change in selection of stimulus A or B as being most similar to the target. Tables 80, 82, and 84 display the chi-square calculations. In all three triads a significant relationship was found for the percentages of change in similarity judgments between preschool participants and adults and the modality of added linguistic labels. That means that in all three triads the age of participants and the modality have an impact on the amount of changed decisions after adding verbal and printed labels to line drawing designs.

In triad I the relationship of age, modality and change in decisions was most contrasting ($\chi^2(3, N = 35) = 37.19, p \leq .01$). As reported in Table 80, adult participants were much more likely to change their decision about the similarity of stimulus A or B to the target when labels were provided in print compared to the preschoolers, who demonstrated the least amount of change with a printed label added. Even though preschoolers displayed more changes in decisions when presented with verbal labels, adult participants, as compared to preschoolers, were even more likely to change their decision when verbal labels were provided.

In triad II the relationship of age and modality was significant for $\chi^2(3, N = 35) = 28.67, p \leq .01$). As reported in Table 82, adults were more likely to change their mind on similarity judgment, when provided with verbal labels for line drawing designs, compared to preschoolers. However, the impact of printed labels (17.65%) compared

with verbal labels (23.53%) was nearly the same for preschoolers in the second triad, whereas verbal labels elicited more changes (50.00%) in adults, when compared to printed labels (27.78%).

In triad III the relationship of age, modality and change in decisions was also significant ($\chi^2(3, N = 35) = 28.42, p \leq .01$). Most contrasting was the impact of the verbal labels in this triad. Adult participants were much more likely to change their decision about the similarity of stimulus A or B to the target (55.56%) compared to the preschoolers (11.77%) (Table 84). Is it also noteworthy that the impact of printed labels was higher (23.53%) than the impact of verbal labels (11.77%) in preschoolers whereas the impact of labels was nearly the same in verbal and printed labels for adults. Further, across all triads the amount of change was the highest for adults when verbal labels were added compared to printed labels.



	Triad I*	Triad II*	Triad III*
verbal label preschoolers	17.65%	23.53%	11.77%
verbal labels adults	38.89%	50.00%	55.56%
printed labels preschoolers	5.88%	17.65%	23.53%
printed labels adults	33.33%	27.78%	44.44%

Figure 14. Preschoolers versus adults: Adding verbal and verbal and printed labels. Percentages of observed frequencies for changes in selection of A and B after adding verbal and after adding printed labels.
* = significant relationship between age and selection of stimulus A or B.

Adding printed labels versus verbal and printed labels.

The amount of change in similarity judgments from one experimental condition (printed labels added) to another experimental condition (verbal and printed labels) in both age groups was calculated. A chi-square analysis was used to determine the relationship between age and modality in similarity judgments.

Triad I.

Table 85. Results After Adding Printed Labels and Verbal and Printed Labels: Adults vs. Preschoolers – Triad I

Choices:	Printed Label Preschoolers	Printed Label Adult	Verbal and Printed Label Preschoolers	Verbal and Printed Labels Adults	Total
Change:	05.88%	33.33%	11.77%	50.00%	100.98%
No Change:	94.12%	66.67%	88.23%	50.00%	299.02%
	100.00%	100.00%	100.00%	100.00%	400.00%

Table 86. Chi-square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Preschoolers change printed	5.88%	25.25%	-19.37%	375.20%	14.86
Preschoolers no change printed	94.12%	74.76%	19.36%	375.20%	5.02
Adults change printed	33.33%	25.25%	8.08%	65.29%	2.59
Adults no change printed	66.67%	74.76%	-8.09%	65.45%	0.88
Preschoolers change verb +print	11.77%	25.25%	-13.48%	181.71%	7.20
Preschool no change verb +print	88.23%	74.76%	13.47%	181.44%	2.43
Adults change verb + print	50.00%	25.25%	24.75%	612.56%	24.26
Adults no change verb + printed	50.00%	74.76%	-24.76%	613.06%	8.20
					65.44

Alpha Level 0.01 → critical value 11.341→ 65.44 > 11.341→ reject Null Hypothesis

Triad II.

Table 87. Results After Adding Printed Labels and Verbal and Printed Labels: Adults vs. Preschoolers Triad II

Choices:	Printed Label Preschoolers	Printed Label Adult	Verbal and Printed Label Preschoolers	Verbal and Printed Labels Adults	Total
Change:	17.65%	27.78%	47.07%	33.33%	125.83%
No Change:	82.35%	72.22%	52.93%	66.67%	274.17%
	100.00%	100.00%	100.00%	100.00%	400.00%

Table 88. Chi-square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Preschoolers change printed	17.65%	31.46%	-13.81%	190.72%	6.06
Preschoolers no change printed	82.35%	68.54%	13.81%	190.72%	2.78
Adults change printed	27.78%	31.46%	-3.68%	13.54%	0.43
Adults no change printed	72.22%	68.54%	3.68%	13.54%	0.20
Preschoolers change verb +print	47.07%	31.46%	15.61%	243.67%	7.76
Preschool no change verb +print	52.93%	68.54%	-15.61%	243.67%	3.56
Adults change verb + print	33.33%	31.46%	1.87%	3.50%	0.11
Adults no change verb + printed	66.67%	68.54%	-1.87%	3.50%	0.05
					20.95

Alpha Level 0.01 → critical value 11.341 → 20.95 > 11.341→ reject Null Hypothesis

Triad III.

Table 89. Results After Adding Printed Labels and Verbal and Printed Labels: Adults vs. Preschoolers Triad III

Choices:	Printed Label Preschoolers	Printed Label Adult	Verbal and Printed Label Preschoolers	Verbal and Printed Labels Adults	Total
Change:	23.53%	44.44%	47.07%	66.67%	181.71%
No Change:	76.47%	55.56%	52.93%	33.33%	218.29%
	100.00%	100.00%	100.00%	100.00%	400.00%

Table 90. Chi-square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Preschoolers change printed	23.53%	45.43%	-21.90%	479.61%	10.56
Preschoolers no change printed	76.47%	54.57%	21.90%	479.61%	8.79
Adults change printed	44.44%	45.43%	-0.99%	0.98%	0.43
Adults no change printed	55.56%	54.57%	0.99%	0.98%	0.02
Preschoolers change verb +print	47.07%	45.43%	1.64%	2.69%	0.06
Preschool no change verb +print	52.93%	54.57%	-1.64%	2.69%	0.05
Adults change verb + print	66.67%	45.43%	21.24%	451.14%	9.93
Adults no change verb + printed	33.33%	54.57%	-21.24%	451.14%	8.27
					38.11

Alpha Level 0.01 → critical value 11.341 → 38.11 > 11.341→ reject Null Hypothesis

The percentages of observed frequencies for changes in selecting stimulus A or B after adding printed labels and verbal and printed labels can be found in Tables 85, 87 and 89. A chi-square test was used to determine if there was an effect of the age of the participant and the modality of linguistic labels on the amount of change in selection of stimulus A or B as being most similar to the target. Tables 86, 88, and 90 display the chi-square calculations. In all three triads a significant relationship was found for the percentages of change in similarity judgments between preschool participants and adults and the modality of added linguistic labels. That means that in all three triads the age of participants and the modality have an impact on the amount of changed decisions after adding verbal and printed labels to line drawing designs.

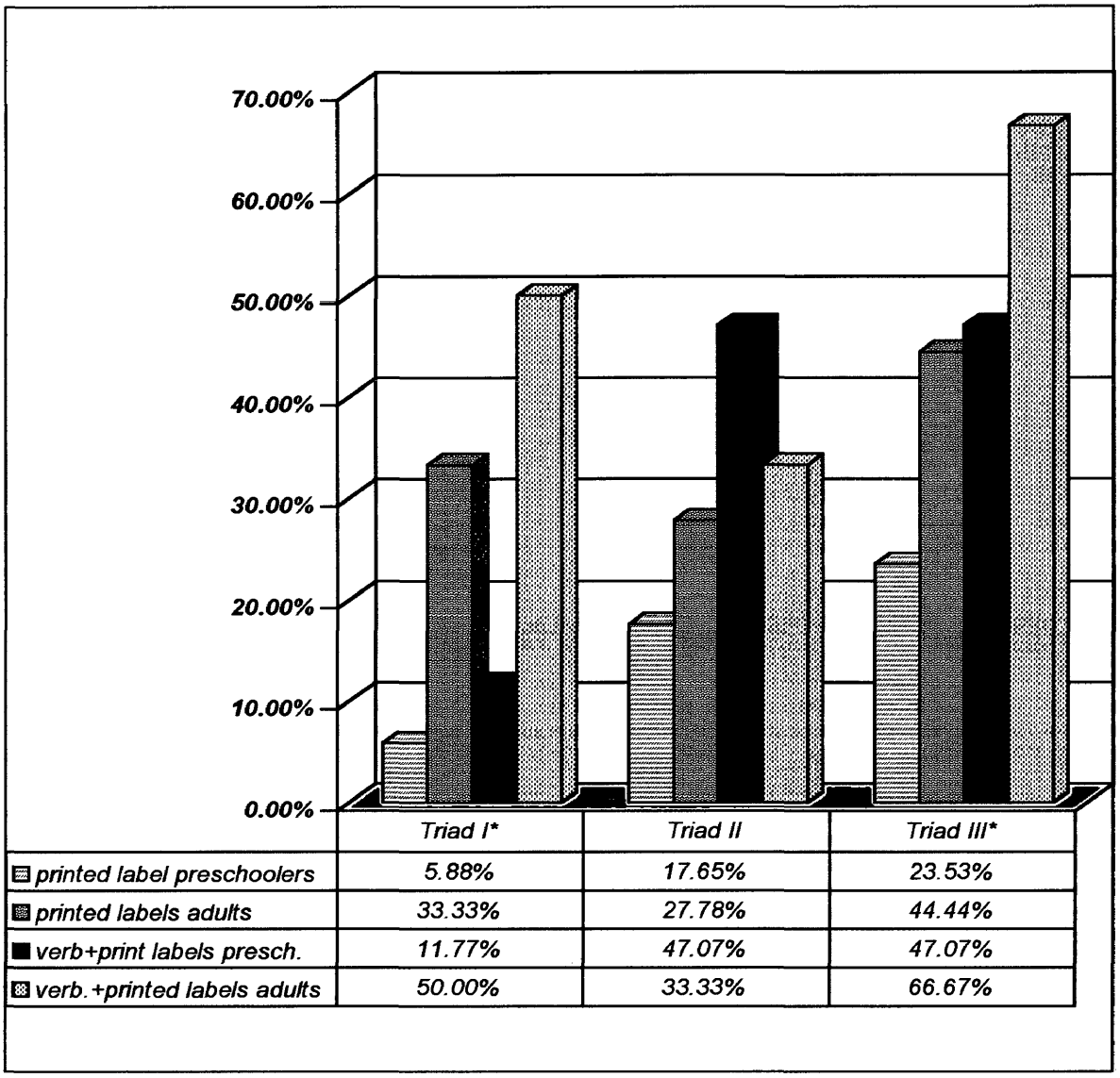
In triad I the relationship of age and change in decisions was most contrasting (Figure 15) ($\chi^2(3, N = 35) = 37.19, p \leq .01$). As reported in Table 86, adult participants were most likely to change their decision about the similarity of stimulus A or B to the target when labels were provided as verbal and printed labels. Also, adult participants were much more likely to change their decision about the similarity when labels were provided a printed words compared to preschoolers. Preschoolers demonstrated least amount of change when printed labels were provided and an increased amount of change when presented as verbal and printed labels, however the amount of change remained lower in both modalities compared to the amount of change exhibited by adult participants.

In triad II the relationship of age and amount of change was significant ($\chi^2(3, N = 35) = 28.67, p \leq .01$). As reported in Table 88, adults were more likely to change their mind on similarity judgment when provided with verbal labels compared to preschoolers. However, different from the other two triads is that preschoolers demonstrated a higher amount of change when provided with verbal and printed labels compared to adults and compared to when just printed labels were given. That means that the greatest likelihood for observing the highest amount of change existed when preschoolers were provided with printed and verbal labels in triad II.

In triad III the relationship between age and modality of label was significant for the amount of changes observed (χ^2 $(3, N = 35) = 28.42, p \leq .01$). Adult participants were much more likely to change their decision about the similarity of stimulus A or B to the target when verbal and printed labels were provided compared to just printed labels and

compared to the amount of changes in preschoolers (Table 90). Preschoolers were least likely to demonstrate changes in their decision when provided with labels in the visual modality. The amount of change increased when the verbal and printed labels were presented however, the amount of changes was significantly lower than the amount of changes observed in adults.

Also, across all triads the amount of change is the highest for adults when verbal and printed labels were added compared to just printed labels. Thus, the auditory presentation in addition to the visual presentation elicited a higher amount of change across all triads in both age groups.



	Triad I*	Triad II	Triad III*
printed label preschoolers	5.88%	17.65%	23.53%
printed labels adults	33.33%	27.78%	44.44%
verb+print labels presch.	11.77%	47.07%	47.07%
verb.+printed labels adults	50.00%	33.33%	66.67%

Figure 15. Preschoolers versus adults: Adding printed and verbal and printed labels. Percentages of observed frequencies for changes in selection of A and B after adding printed and after adding verbal and printed labels.
* = significant relationship between age and selection of stimulus A or B.

Adding verbal labels versus verbal and printed labels.

The amount of change in similarity judgments from one experimental condition (verbal labels added) to another experimental condition (verbal and printed labels added) in both age groups was calculated. A chi-square analysis was used to determine the relationship between age and modality in similarity judgments.

Triad I.

Table 91. Results After Adding Verbal Labels and After Adding Verbal and Printed Labels: Adults vs. Preschoolers – Triad I

Choices:	Verbal Label Preschoolers	Verbal Label Adult	Verbal and Printed Label Preschoolers	Verbal and Printed Labels Adults	Total
Change:	17.65%	38.89%	11.77%	50.00%	118.31%
No Change:	82.35%	61.11%	88.23%	50.00%	281.69%
	100.00%	100.00%	100.00%	100.00%	400.00%

Table 92. Chi-square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Preschoolers change verbal	17.65%	29.58%	-11.93%	142.33%	4.81
Preschoolers no change verbal	82.35%	70.42%	11.93%	142.33%	2.02
Adults change verbal	38.89%	29.58%	9.31%	86.68%	2.93
Adults no change verbal	61.11%	70.42%	-9.31%	86.68%	1.23
Preschoolers change verb +print	11.77%	29.58%	-17.81%	317.20%	10.73
Preschool no change verb +print	88.23%	70.42%	17.81%	317.20%	4.50
Adults change verb + print	50.00%	29.58%	20.42%	416.98%	14.10
Adults no change verb + printed	50.00%	70.42%	-20.42%	416.98%	5.92
					46.24

Alpha Level 0.01 → critical value 11.341 → 46.24 > 11.341→ reject Null Hypothesis

Triad II.

Table 93. Results After Adding Verbal Labels and Verbal and Printed Labels: Adults vs. Preschoolers Triad II

Choices:	Verbal Label Preschoolers	Verbal Label Adult	Verbal and Printed Label Preschoolers	Verbal and Printed Labels Adults	Total
Change:	23.53%	50.00%	47.07%	33.33%	153.93%
No Change:	76.47%	50.00%	52.93%	66.67%	246.07%
	100.00%	100.00%	100.00%	100.00%	400.00%

Table 94. Chi-square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Preschoolers change verbal	23.53%	38.48%	-14.95%	223.50%	5.80
Preschoolers no change verbal	76.47%	61.52%	14.95%	223.50%	3.63
Adults change verbal	50.00%	38.48%	11.52%	132.71%	3.45
Adults no change verbal	50.00%	61.52%	-11.52%	132.71%	2.16
Preschoolers change verb +print	47.07%	38.48%	8.59%	73.78%	1.92
Preschool no change verb +print	52.93%	61.52%	-8.59%	73.78%	1.20
Adults change verb + print	33.33%	38.48%	-5.15%	26.52%	0.69
Adults no change verb + printed	66.67%	61.52%	5.15%	26.52%	0.43
					19.28

Alpha Level 0.01 → critical value 11.341 → 19.28 > 11.341 → reject Null Hypothesis

Triad III.

Table 95. Results After Adding Verbal Labels and Verbal and Printed Labels: Adults vs. Preschoolers – Triad III

Choices:	Verbal Label Preschoolers	Verbal Label Adult	Verbal and Printed Label Preschoolers	Verbal and Printed Labels Adults	Total
Change:	11.77%	55.56%	47.07%	66.67%	181.07%
No Change:	88.23%	44.44%	52.93%	33.33%	218.93%
	100.00%	100.00%	100.00%	100.00%	400.00%

Table 96. Chi-square Analysis

	O	*E*	*O-E*	*(O-E)2*	*(O-E)2/E*
Preschoolers change verbal	11.77%	45.27%	-33.50%	1122.25%	24.80
Preschoolers no change verbal	88.23%	54.73%	33.50%	1122.25%	20.50
Adults change verbal	55.56%	45.27%	10.29%	105.88%	2.34
Adults no change verbal	44.44%	54.73%	-10.29%	105.88%	1.93
Preschoolers change verb +print	47.07%	45.27%	1.80%	3.24%	0.07
Preschool no change verb +print	52.93%	54.73%	-1.80%	3.24%	0.06
Adults change verb + print	66.67%	45.27%	21.40%	457.96%	10.12
Adults no change verb + printed	33.33%	54.73%	-21.40%	457.96%	8.37
					68.19

Alpha Level 0.01 → critical value 11.341 → 68.19 > 11.341→ reject Null Hypothesis

The percentages of observed frequencies for changes in selecting stimulus A or B after adding verbal labels and verbal and printed labels can be found in Tables 91, 93 and 95. A chi-square test was used to determine if there was an effect of the age of the participant and the modality of linguistic labels on the amount of change in selection of stimulus A or B as being most similar to the target. Tables 92, 94, and 96 display the chi-square calculations. In all three triads a significant relationship was found for the percentages of change in similarity judgments between preschool participants and adults and the modality of added linguistic labels. That means that in all three triads the age of participants and the modality have an impact on the amount of changed decisions.

In triad I the relationship of age, modality and amount of change in decisions was of significance (Figure 16) (χ^2 (3, N = 35) = 46.24, $p \leq .01$). As reported in Table 92, adults were more likely to change their decision about the similarity of stimulus A or B to the target when verbal labels were provided (38.89%) compared with preschoolers who demonstrated minimal changes with verbal labels (17.65%). However, adult participants were more likely to change their decision about the similarity with the labels in both modalities (verbal and printed) (50.00%). Preschoolers demonstrated least amount of change when verbal labels were provided (11.77%),

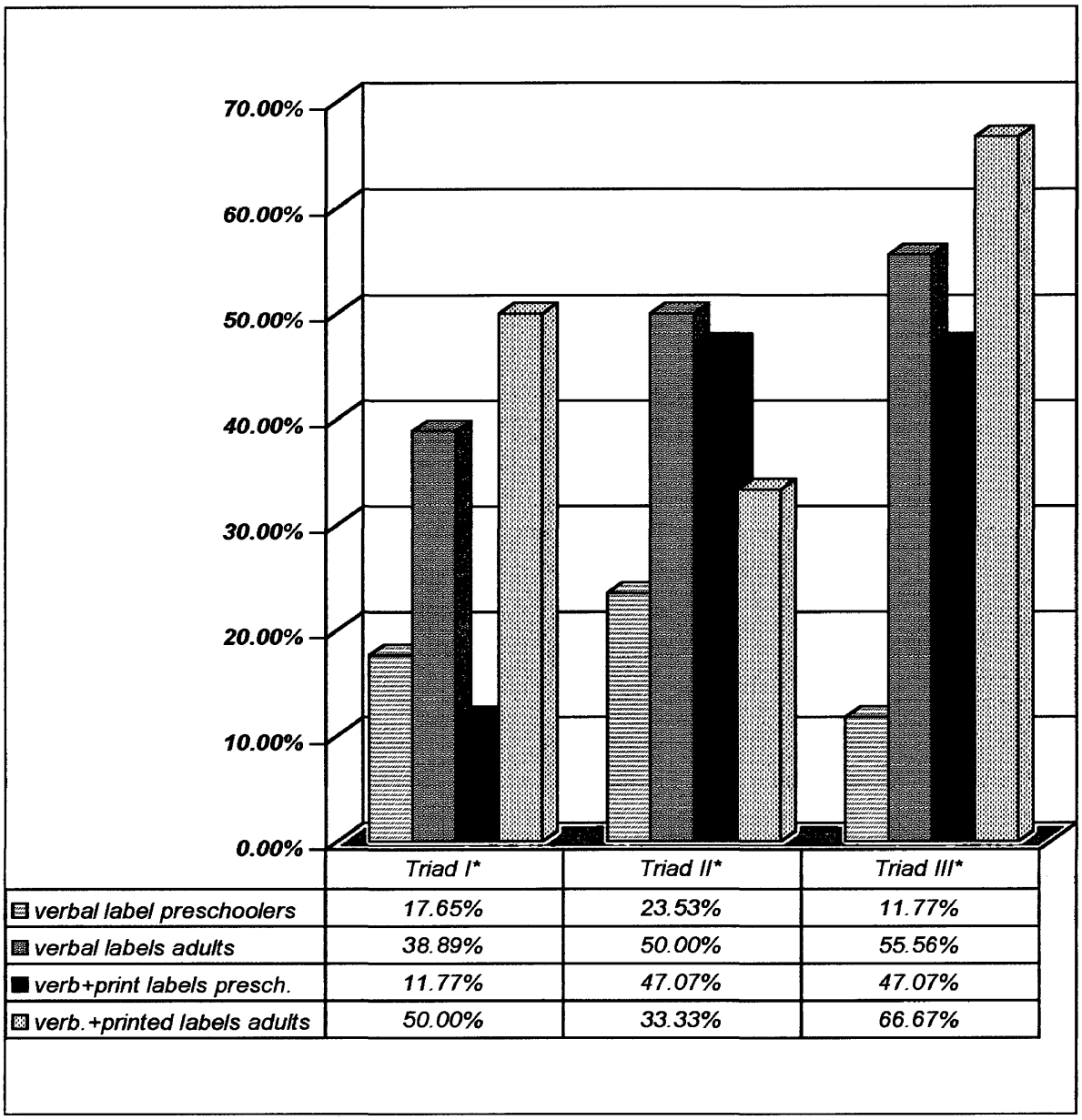
In triad II the relationship of age and similarity judgment was significant for χ^2(3, N = 35) = 19.28, $p \leq .01$). As reported in Table 94, adults were more likely to change their mind on similarity judgment when provided with verbal labels (50.00%) compared to preschoolers (23.53%). That means that the greatest likelihood for observing the highest amount of change existed for preschoolers when they were provided with printed and verbal labels in triad II (47.07%). For adults the additional verbal labels elicited the greatest amount of changes in triad II (50.00%).

In triad III the relationship between age and modality of label was most contrasting (χ^2(3, N = 35) = 68.19, $p \leq .01$). Adult participants were more likely to change their decision about the similarity of stimulus A or B to the target when provided with verbal and printed labels (66.67%) compared to just verbal labels (55.56%) and compared to the likelihood of changes in preschoolers in both modalities (Table 96).

Preschoolers were least likely to demonstrate changes in their decision when provided with verbal labels (11.77%). The amount of change increased significantly

when the verbal and printed labels were presented (47.07%), however, the amount of changes was lower in both modalities than the amount of changes observed in adults.

Also, in triads I and III the amount of change was the highest for adults when verbal and printed labels were added compared to just verbal labels. In triads II and III the amount of change was the highest for preschoolers when verbal and printed labels were added compared to just verbal labels. Thus, the auditory presentation in addition to the visual presentation elicited a higher amount of change across all triads when compared to presenting just the printed label, but this was not observed in both age groups. The verbal label impacted the decision more than the combination of a printed and verbal label in one of three triads in each age group.



	Triad I*	Triad II*	Triad III*
verbal label preschoolers	17.65%	23.53%	11.77%
verbal labels adults	38.89%	50.00%	55.56%
verb+print labels presch.	11.77%	47.07%	47.07%
verb.+printed labels adults	50.00%	33.33%	66.67%

Figure 16. Preschoolers versus adults: Adding verbal labels and verbal and printed labels. Percentages of observed frequencies for changes in selection of A and B in preschoolers and adults after adding verbal and after adding verbal and printed labels
* = significant relationship between age and selection of stimulus A or B.

Summary: Between Age Group Comparisons of Experimental Conditions

In all three triads adding a linguistic label elicited more changes in adults than in children except for adding printed and verbal labels in triad II. There, preschoolers demonstrated more changes (47.07%) than adults (33.33%). However, the relationship of age and amount of the amount of change in this case is of low significance χ^2 (3, N = 35) = 3.92, $p \leq .05$).

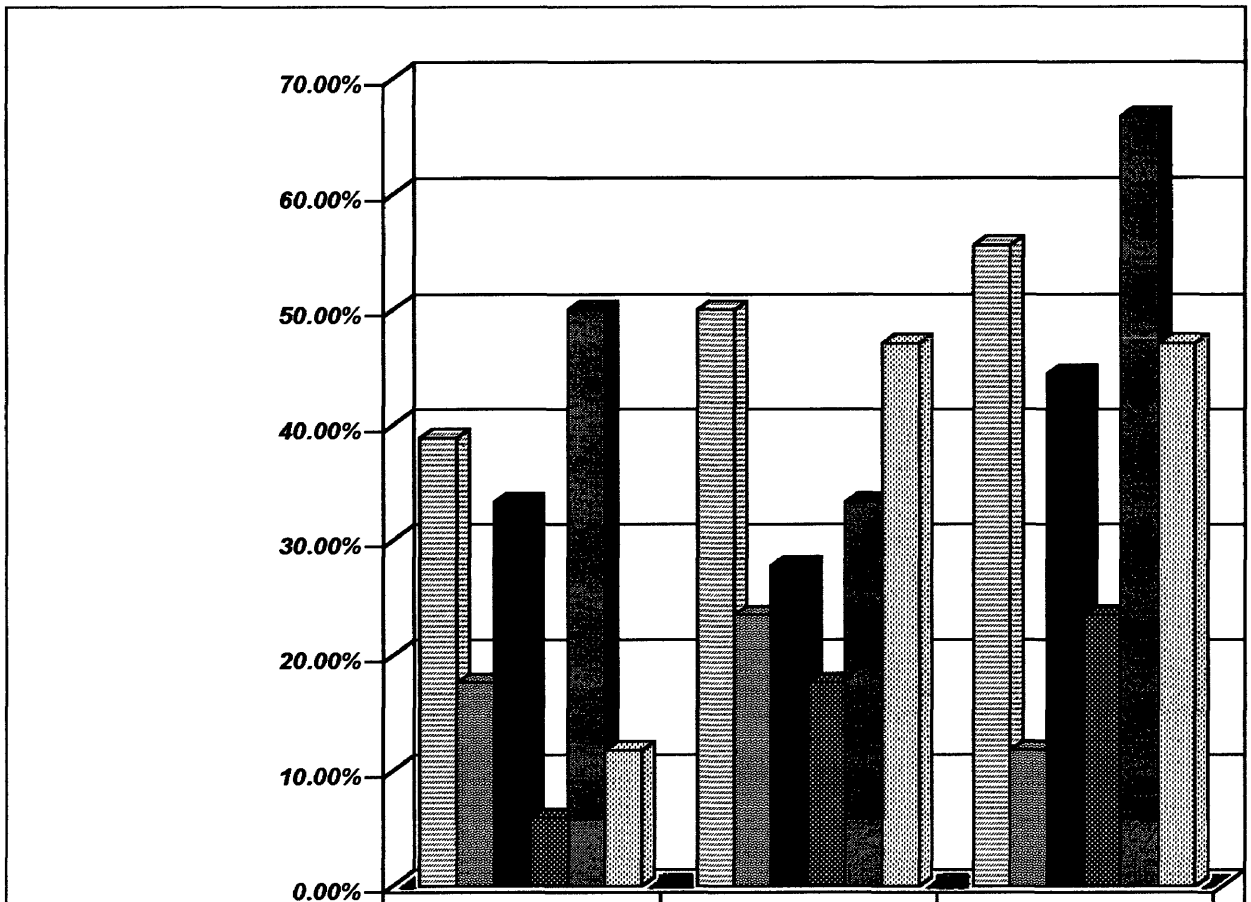
Further, there was a significant relationship between the amount of changes in adults and preschoolers when a verbal label was provided. Adults always demonstrated more changes than preschoolers. The same effect was observed with printed labels. In triad I and III the presentation of verbal and printed labels elicited significantly higher amounts of change in similarity judgments. In triad II the preschoolers demonstrated more changes with printed and verbal labels compared to adults. Figure 17 displays all discussed results.

Summary: Between Age Group Comparisons of Experimental Condition

The presentation of a verbal label compared to a printed and verbal label lead to a greater amount of change in similarity judgment in both age groups. However, the relationship of auditory versus visual modality was only significant for triad II in adults and triads I and III for preschoolers. When comparing the presentation of a label provided in just the auditory modality (verbal label) with the label given in a combination of the auditory and visual modality (verbal and printed label), the relationship of amount of change and modality was significant for triad II in adults and preschoolers. Preschoolers

further demonstrated significantly more changes in triad III, whereas adults did not display a higher number of changes there.

When comparing the presentation of printed labels with verbal and printed labels, the relationship of amount of change and modality was significant in triad III for both age groups. Further, preschoolers displayed significantly more changes with verbal and printed and spoken labels compared to just printed labels in triad II (Tables 97 and 98).



	Triad I	Triad II	Triad III
Verbal Labels Adults	38.89%	50.00%	55.56%
Verbal Labels Children	17.65%	23.53%	11.77%
Printed Label Adults	33.33%	27.78%	44.44%
Printed Labels Children	5.88%	17.65%	23.53%
Verb.+Printed Labels Adults	50.00%	33.33%	66.67%
Verb.+Printed Labels Children	11.77%	47.07%	47.07%

Figure 17. Summary: The effect of modality and age on similarity judgment. Percentages of change in each experimental condition and each triad for both age groups.

Table 97. Comparisons Between All Experimental Conditions - Adults

	Triad I	Triad II	Triad III
Verbal – Printed	$\chi^2 = 0.66$	$\chi^2 = 10.38$	$\chi^2 = 2.48$
	Accept Null Hypothesis	Reject Null Hypothesis	Accept Null Hypothesis
Verbal – Verbal + Printed	$\chi^2 = 2.5$	$\chi^2 = 5.72$	$\chi^2 = 2.60$
	Accept Null Hypothesis	Reject Null Hypothesis	Accept Null Hypothesis
Printed – Verbal + Printed Label	$\chi^2 = 5.74$	$\chi^2 = 0.72$	$\chi^2 = 10.02$
	Reject Null Hypothesis	Accept Null Hypothesis	Reject Null Hypothesis

n = 18; age mean = 26;05 years; range = 20;07 – 47;05 years

Table 98. Comparisons Between All Experimental Conditions - Preschoolers

	Triad I	Triad II	Triad III
Verbal – Printed	$\chi^2 = 6.66$	$\chi^2 = 1.06$	$\chi^2 = 4.76$
	Reject Null Hypothesis	Accept Null Hypothesis	Reject Null Hypothesis
Verbal – Verbal + Printed	$\chi^2 = 1.38$	$\chi^2 = 12.12$	$\chi^2 = 30.00$
	Accept Null Hypothesis	Reject Null Hypothesis	Reject Null Hypothesis
Printed – Verbal + Printed Label	$\chi^2 = 2.14$	$\chi^2 = 19.78$	$\chi^2 = 12.12$
	Accept Null Hypothesis	Reject Null Hypothesis	Reject Null Hypothesis

n = 17; age mean = 4;05 years; range = 4;1 – 4;11 years

CHAPTER 5

Discussion

The purpose of this study is to examine the impact of linguistic features on visual non-linguistic perception in similarity judgment tasks. As Sloutsky and Lo (1999) have found, 5- to 7-year-old children base their judgment on verbal labels more often than do adults. In this study linguistic features are provided in the form of spoken words, printed words, as well as spoken and printed words. Further, the developmental nature of similarity judgment is examined by comparing the performance of preschoolers with adults. Sloutsky and Lo have reported that the effect of a linguistic feature is of quantitative nature and diminishes during childhood. That is, 5-to 7-year-old children rely most on verbal labels, 7-to 9-year-old children demonstrate mixed results and 9-to 11-year-olds do not base their decision regarding similarities on labels anymore.

Sloutsky and Lo (1999) have investigated the effect of shared labels added to line drawings. Therefore they have attached labels to schematic faces. These labels are pseudowords, for example "guga", "luga" and "bala". Their findings reveal that under this experimental condition the age of the participant correlates with the reliance on linguistic labels of objects in similarity judgment tasks. The older the children are, the lower the likelihood that they base their decision on the presence of a *shared* label. The present study examines the effect of *phonologically similar* (rhyming) labels added to line drawings.

The following will discuss the findings of this study. First all results are briefly discussed. Then, the outcomes are interpreted in more detail. Conclusions and implications follow.

Control Condition

Preschoolers

The function of the control condition is to establish a baseline for similarity judgment of non-linguistic visual features in the form of line drawings. In triad I the majority of the children (82.35%) decide that stimulus B is more similar to the target (T) than stimulus A. In triad II nearly two thirds of the preschoolers agree on stimulus B to be most similar to the target. In triad III the selection of stimulus A or B is almost evenly divided (Appendix D).

An association with a familiar object (i.e. as stated by one girl "planet", "letter Z" and "crown") may have accounted for preschoolers' decisions in triads I and II. A majority of the children have possibly used a gestalt association strategy by searching for overall similarity to an associated familiar object. However, in triad III the results are mixed. There, the strategy may not have been as helpful, because the overall gestalt of all three line drawings could have matched an associated familiar object. Triad III most likely demands an analytical feature approach that is typically emerging during the preschool years (Alexander & Enns, 1988; Aslin & Smith, 1988; Landau, Smith, & Jones 1997).

Adults

Among adult participants there is a high consistency in the similarity judgment of line-drawing designs. Seventeen out of 18 participants have selected stimulus B as being most similar in triads I and III. Sixteen out of 18 have selected stimulus B in triad II. This high consistency can be explained by established conventional feature weights that are used in feature comparison tasks (Alexander & Enns, 1988).

Experimental Conditions

Adding Verbal Labels – Preschoolers

After adding the verbal label to the line-drawings, 3 of 17 children (17.65%) change to the other stimulus in Triad I, 4 of 17 children (23.53%) change in Triad II and 2 of 17children (11.77%) change in Triad III (Figure 17, Table 98). Because the documented changes do not exceed a chance level of 50% it is concluded that adding verbal labels does not affect the similarity judgment of the participating 4–year old children.

The fact that only minimal changes are observed with the presentation of verbal labels is contrary to prior findings by Sloutsky and Lo (1999) who documented a change in more than half of their 5- to 7-year-old participants. This is possibly due to the age difference of participants. Children gain cognitive abilities that allow different performance in metacognitive tasks.

In Sloutsky and Napolitano's study (2003) the majority of the 4-year-old children have based their decisions on added auditory features in the form of tones. Since these auditory stimuli do not contain linguistic features it is not possible to compare these two

outcomes. Conclusions about the underlying motivation for changes observed in the 4-year olds of the present study can only be speculated. All, except one of the preschoolers who display a change in their selection have not demonstrated the ability to identify rhymed word-pairs during the pre- or post-rhyming screening.

Adding Verbal Labels – Adults

The results of the experimental condition for adding verbal labels indicate that in one of the three triads there is an effect on the similarity judgments when adding a verbal label to line drawing designs. It was hypothesized that adults would not change their mind after being provided with linguistic labels that rhyme based on the findings reported by Sloutsky and Lo (1999), in which adults consistently demonstrate resistance to the presentation of *shared labels*. However, in this research study the changes exceed the chance level of 50% in one of three triads (Figure 17, Table 97). Adding *phonologically similar labels* versus a shared label reveals a different outcome for adult participants.

Adding Printed Labels – Preschoolers

Six children display a change of stimulus selection after adding a printed label across all three triads (Appendix D). Two of the 6 children demonstrate a consistent orientation to the phonologically similar label in two of all three triads. The other children display changes according to the label in one of the three triads. Since the changes, after adding the verbal label, are below the chance level (50%) it is concluded that there is no effect on similarity judgment when adding a printed label. The findings in this study are consistent with the findings of Sloutsky and Lo (1999) in that the

presentation of a visual linguistic label (a manually presented sign or a printed word) does not affect the similarity judgments of young children.

Since all preschoolers are at a pre-literate developmental stage, is it note worthy that only one boy has stated that he could not read. Due to the few children who display a change, it can be speculated that the majority of the children may have ignored the printed label. This is also likely because subjectively no increase in the response time has been noted. The children have pointed to the stimuli without any hesitation.

Adding Printed Labels – Adults

After adding the printed labels,10 of 18 adults chose the stimulus containing the printed label most similar to the target (Appendix E). Four of 18 adults demonstrated consistent responses according to the rhyming labels provided in the visual modality. Further, 1 adult displayed a change in two of three triads and 5 more adults were observed changing their mind in one of the three triads according to the similarity of the printed label. These results are interpreted to mean that there is no effect in similarity judgment in adults when adding a printed label to line drawing designs. It was hypothesized that adults would not demonstrate changes after being provided with a similar printed label because prior studies by Sloutsky and Lo (1999) have revealed that adults do not base their decision on shared visual linguistic features (hand signs) in similarity judgment tasks. Therefore, it is concluded that printed labels do not affect similarity judgment (Null Hypothesis 2) for the adult age group.

Adding Verbal and Printed Labels – Preschoolers

When both verbal and printed labels are added to line drawing designs, children demonstrate the highest frequency of change in favor of the stimulus items paired with the labels that rhymed with the target (Appendix D). However, the amount of change does not exceed the chance level in any triad (Figure 17, Table 98) . Since it was hypothesized that children would not demonstrate significant changes after adding verbal and printed labels to the line drawing designs, (Null Hypothesis 3) it is concluded that the 4-year-old participants' similarity judgments are not affected by adding verbal and printed labels to line drawings.

Adding Verbal and Printed Labels – Adults

When both verbal and printed labels are added to the line drawing designs, adults demonstrate the highest frequency of change in favor of the stimulus items paired with the rhymed labels most similar to the target in all experimental conditions. Fourteen out of 18 adults demonstrate changes across all three triads (Appendix E). Five of these 14 adults chose the stimulus containing the rhymed label *consistently* across all three triads, and another 4 of the 14 adults display this behavior in two of the three triads. Five adults change their mind in one of the three triads to the rhymed label. In triad III 66.67% of the adults display a change according to the rhymed label. It was hypothesized that adults would not demonstrate any changes after adding the verbal and printed labels to the line drawing designs, (Null Hypothesis 3). For the adult age group the number of changes exceeds chance level (50%) in triad III. In the other two triads the changes do not exceed chance.

Summary

Both the children and the adults have demonstrated changes in their stimulus selections when the verbal label was provided. For the children, this is contrary to previous findings. This may be accounted for by the difference in ages between this study and prior research. Adults also exhibit changes that are interpreted to mean there is an effect of verbal label on similarity judgments. This also conflicts with prior research. However, for both the children and the adults, there is not consistency across the triads.

Neither the children nor adult groups demonstrate significant changes in the printed label condition overall. However, within each group and across the triads there is evidence of variance.

Finally, there is evidence that both groups of participants frequently change their choice of stimuli when both the verbal and printed labels were presented. The effect is greater for adults than for children. It is likely that the additional features presented in combination with the line drawings provided sufficient feature weight to effect a change in the adult participants. However, the variance across triads is evident in this condition, as it was in the other two conditions.

It would appear that the line drawings used in the three different triad conditions might have differed in visual complexity or the number of features available to participants for consideration. Although there is not a definitive pattern, and despite the fact that the order of stimulus presentation was rotated across participants groups, there appears to be sufficient variance among the triads to justify this conclusion. Therefore,

the features of the line drawing stimuli may confound the effect of adding labels in any form.

Relationships between Modalities of Linguistic Labels

Verbal versus Printed Labels – Preschoolers

The comparison between the verbal and printed labels in preschoolers was hypothesized to be indifferent. Results of prior studies by Sloutsky and Lo (1999) have revealed that *shared verbal labels* contribute significantly more to similarity judgment than shared visual linguistic features in the form of hand signs. In the present study there were *phonologically similar* labels used in both modalities. Therefore, the observed significant difference between the auditory and visual modality in Sloutsky and Lo's study was not assumed in this experiment. However, in the present study *verbal* labels have contributed significantly more to changes in judgments compared to printed labels in one of three triads (Figure 17, Table 97). On the contrary, in triad III the printed labels have contributed significantly more to changes in the preschoolers' judgments than the verbal labels. There are no significant differences between verbal and printed labels in the second triad.

In conclusion, the mixed outcomes are all within chance level. The fact that the participants in this study are not yet able to read but demonstrate more changes when printed words are presented in triad III underscores the data. It was noted that, with one exception, they are not bothered by the fact they could not read. It appears they simply disregarded the printed label as a feature they could not relate to/afford particular weight. More over the analysis of the words may have lead to an increased processing time to

analyze the printed labels, but this has not been subjectively observed. It is concluded that there is no significant difference between labels presented in the auditory as compared to the visual modality, for these 4-year-old participants.

Verbal versus Printed Labels– Adults

The comparison between verbal and printed labels was hypothesized to be indifferent for adults. However, the outcomes indicate that verbal labels contribute significantly more often to a change in judgments compared to printed words in one triad (Figure 17, Table 98). In the other two triads, adults also tend to demonstrate more changes with verbal labels than with printed labels but the amount of change does not exceed chance level. Thus, the Null Hypothesis 4 for adults is rejected for triad II, but accepted for triads I and III.

Verbal versus Verbal and Printed Labels– Preschoolers

A comparison between the verbal and verbal and printed labels was performed in order to test Null Hypothesis 5, which states that there is no relationship in the amount of changes after adding a verbal label compared to adding a verbal and printed label. Results suggest that there is a relationship between the modality of the label and the amount of changes. Adding verbal and printed labels significantly increases the likelihood to observe changes in two triads (Figure 17, Table 97). Thus, the Null Hypothesis 5 for preschoolers is rejected for triads II and III, but accepted for triad I.

Verbal versus Verbal and Printed Labels– Adults

It was hypothesized that there is no relationship between the amount of changes and labels provided in the auditory modality versus labels provided in the auditory and

visual modality. Results suggest a rejection of the Null Hypothesis 5 in adults in one of the three triads (Figure 17, Table 98). However, the value of chi-square points to a weak relationship between the modality of the label and the number of changes, even though there is a significant difference in this triad. In the other two triads the Null Hypothesis 5 is accepted. Verbal labels are as likely as verbal and printed labels to contribute to changes in similarity judgment in adults (Figure 17, Table 89).

Printed versus Verbal and Printed Labels – Preschoolers

The Null Hypothesis 6 states that there is no relationship between the amount of change in similarity judgments after adding a printed label compared to adding a verbal and printed label. Observed results reveal that indeed there is a relationship between the modality of linguistic labels and the amount of changes. Adding a verbal and printed label significantly increased the likelihood to observe changes in two of three triads (Figure 17, Table 97). Thus, the Null Hypothesis 6 for preschoolers is rejected for triads II and III, but accepted for triad I. Due to the fact that the preschoolers have not yet acquired sufficient literacy skills, this outcome appears logical.

Printed versus Verbal and Printed Labels – Adults

The comparison between the printed and verbal and printed label conditions was hypothesized to be indifferent for adults. However, the outcomes indicate that the contribution of verbal and printed labels is significantly higher compared to printed labels in two of the three triads (Figure 17, Table 98). In triads I and III the contribution of a printed label is significantly different from a verbal and printed label. Adults demonstrate

more changes with verbal and printed words than with exclusively printed words. Thus, the Null Hypothesis 6 for adults is rejected for triads I and III, but accepted for triad II.

Summary

Across all three triads preschoolers demonstrate changes in 15% of their responses when provided with verbal labels *or* printed labels. Further, 35% of the 4-year-olds demonstrate changes when verbal *and* printed labels were provided. Even though all changes are below the chance level there are tendencies observable. When preschoolers are presented with verbal *and* printed labels, the feature weight of the linguistic label increases due to the simultaneous presentation of auditory and visual linguistic features. Children may have interpreted the providence of the verbal label in addition to the printed label as though the label is being read to them and therefore may have taken it as a cue to increase attention to this feature.

Adults demonstrate the following changes in stimulus selection across all three triads: 48% of the adult participants change their decision according to the rhyming pair when verbal labels are provided, 35% change their selection with printed labels, and 52% demonstrated change when presented with the verbal and printed label. For adults, the key is the auditory input. Thus, when intending to elicit a change in similarity judgment of line drawings, the introduction of verbal and printed labels will be most effective for adults. Adults are more sensitive to the similarity among linguistic features when provided auditory input compared to visual input alone but the strongest impact of linguistic features can be expected when providing both auditory *and* visual stimulus presentation.

The Effect of Age on Similarity Judgment

Control Condition

In two of the three triads a significant relationship exists between the number of choices for stimulus A and B and the age of the participants. In triad I the majority of both age groups chose stimulus B as being most similar. For triad II and III, the number of choices for stimulus A and B are significantly different among the two age groups. In other words, preschoolers judged line drawing designs without any linguistic labels in two of three triads significantly different than adult participants' judgments. Therefore, the Null Hypothesis 7 is accepted for triad I, but rejected for triads II and III

While one preschooler has spontaneously offered her associations to the line drawings, none of the adults have done so. The young girl's information was found to be very valuable and therefore a random sample (n = 5) of adult participants were asked for their associations after the last testing session was completed. In triad I all 5 adults stated that the line drawing reminded them of a globe or planet, in triad II 3 of 5 adults associated the line drawings with a tinker toy and 2 of 5 with some kind of science or chemistry related object. Line drawings in triad III were associated with mountains by all 5 adults. Thus, the reason for the differences in judgments of mere line drawings could possibly stem from a different association when presented with the unfamiliar test stimuli due to different experiential knowledge and background.

Adding Verbal Labels – Preschoolers versus Adults

Except in the adults' triad III, the percentages of change are within chance level for both participating age groups. However, a significant difference between the two age

groups across all three triads was observed when verbal labels were added. Therefore the Null Hypothesis 8 (there is no relationship between the two age groups and the amount of changes when adding a verbal label) can be rejected. The significant difference between age groups' attention to verbal labels may be explained developmentally. The nature of auditory memory and the ability to attend to line drawings and auditory stimuli simultaneously is more demanding for children than for adults. Judgments based on verbal labels require holding the labels in short term memory long enough to be analyzed, which may exceed the auditory memory capacity of 4-year-old children.

Adding Printed Labels – Preschoolers versus Adults

Even though the percentages of change are within chance level for both participating age groups there is a clear trend of adults relying more on printed labels than preschoolers. Thus, the null hypothesis of research question 9 can be rejected. There is a relationship between the age of the participants and the amount of change when a printed label is added to line drawings. The pre-literate developmental stage of preschoolers most likely contributes to this outcome.

Adding Verbal and Printed Labels – Preschoolers versus Adults

The recorded changes after adding verbal printed labels reveal a significant difference between the two age groups across all three triads even though the percentages of change for preschoolers are within chance level for both participating age groups. Adults demonstrate greater than chance performance in triad III. Even though the changes in triads I and II are below chance level the observed performances in all three

triads are significantly different between the two age groups. Therefore, the Null Hypothesis 10 can be rejected.

Comparing the Effect of Modality and Age

Verbal versus Printed Labels – Preschoolers versus Adults

The Null Hypothesis 11 states that there is no relationship between the amount of change when adding a verbal versus a printed label and the age of the participants. Across all three trials there are significant differences between the effect of the linguistic feature modality (verbal or printed) and the age of the participant. Thus, the Null Hypothesis for 11 can be rejected. The results appear logical since the literacy skills differ greatly among the two age groups. However, the outcome was not expected because preschoolers could have identified similarity among printed labels by analyzing general word forms and letter appearance. Since only one child pointed out that he could not read the labels, it is assumed that the majority of the children simply ignored the printed labels, which is significantly different from the adult behavior. The fact that the percentages of change are below chance level for both age groups is an important point when comparing these results to Sloutsky and Lo's (1999) outcomes. The present study reveals new findings compared to the research study by Sloutsky and Lo. Even though they concur in the fact that preschoolers base their decision more often on auditory features than on visual linguistic features, the high percentages of change in the preschool children occur *only* when *shared* labels were provided. Importantly, according to the results of this study, an increase in reliance on linguistic labels in adults can be observed when adults are provided with *rhymed* labels versus *shared* labels. This effect can possibly be explained

with development of vocabulary and acquisition of taxonomy as well as with the way the phonological lexicon is organized. This will be address further on in the text.

Verbal versus Verbal and Printed Labels – Preschoolers versus Adults

When comparing verbal labels and verbal and printed labels among both age groups results reveal significant differences in the modality of linguistic features and age groups in triads I and III. The observed changes in adult participants are above chance level in triad III in the experimental condition where verbal and printed labels are added. Therefore the Null Hypothesis 12 stating there is no difference in experimental conditions among the two age groups is rejected in triad III. The Null Hypothesis 12 is also rejected for triad I and triad II. However, in contrast to triad III, the percentages of change in both triads are below chance level. Thus, adult participants are more likely to base their decision on verbal and printed labels than children and also prefer to base their decision on verbal and printed labels rather than on just verbal labels alone.

Printed versus Verbal and Printed Labels – Preschoolers versus Adults

The Null Hypothesis 13 assumes no difference in the effect of adding printed versus verbal and printed labels to line drawings and the amount of changes observed in the two age groups. As mentioned earlier, the undeveloped reading skills in preschoolers strongly contribute to the significant difference in the effect of visual modality versus auditory and visual modality. The results of this study suggest a rejection of the Null Hypothesis 13 for all three triads.

Conclusions and Implications

Similarity Judgment and the Impact of Linguistic Features in Preschoolers

The rhyming screenings at the beginning and end of the experiment reveal that the majority of the 4-year-old participants could not identify rhymes. Consequently, the question to be asked is why some preschoolers display a change in their decision and orient themselves to the rhymed labels presented in this study.

One possible explanation for the observed behavior in children who did change to the rhymed label is that they may have recognized the phonological similarity secondary to their epilinguistic ability. Epilinguistic ability can be understood as the precursor to the metalinguistic skill of rhyme identification. Epilinguistic behavior "lacks any kind of conscious management" even though the cognitive ability to detect phonological similarity is developed (Gombert, 1992, p. 175). Therefore, it is speculated that the preschoolers in this study are able to detect phonological similarity among labels and base their judgment on the rhymed pairs, but they are not able to demonstrate this skill in the rhyming tasks where they are asked to identify rhymes. Detecting rhymes is an ability that precedes the ability to identify rhymes. Thus, these 4-year-olds may be able to detect rhyming words, though because they have not yet developed the ability to transfer their phonological awareness from an unconscious (epilinguistic) level to a conscious (metalinguistic) level, they give incorrect answers in rhyme identification tasks.

This explanation implies that children who demonstrate rhyming skills at a developmentally more mature level would choose the phonologically more similar stimulus. Because this pattern is not evident in more than one triad, it can be concluded

that phonological similarity does not override visual feature weights of line drawings in this age group.

Nevertheless, it could be argued that the observed changes are related to inconsistent judgment patterns within participants indicating an existing uncertainty in their responses. Due to the fact that some preschoolers chose the rhymed label consistently in more than one triad and also across the experimental conditions (for example when verbal labels are added and when verbal and printed labels are added), an uncertainty in decisions is less likely as an explanation for their performance (Appendix E).

There is an indication for the assumption that some children are able to detect phonological similarity among presented labels. Some children were observed to nod their head when the rhyming pair was recognized during the testing question (e.g. "Does this /guga/ go with this /luga/ (head nodding observed) or does this /migu/ go with this /guga/ (response observed, pointing to the stimulus with the rhymed label). This indicates these children may have been exhibiting emergent metalinguistic skills and a preference to base their judgment on similar linguistic labels.

Similarity Judgment and the Impact of Linguistic Features in Adults

The label-as-an-attribute theory assumed in Sloutsky and Lo's work has revealed a decrease in the impact of linguistic labels with an increase in age. That is because the status of the linguistic label changes over the course of linguistic and cognitive development from being a feature of the object to an arbitrary entity that contains the conceptual properties of the object.

There is another explanation for the dynamic feature weights over the course of time. Let us suppose, participants are presented with a triad of unfamiliar line drawing designs (A, B, and T), which contain a certain number of features all three have in common. In addition, objects A and T both share one critical distinctive feature and objects B and T share another, different critical distinctive feature. When deciding whether A or B is more similar to T, participants are forced to choose which one critical feature is assigned more salience. Participants will proceed by matching the features to a known object prototype (i.e. in triad I of the present study "planet") and base their decision on that distinctive feature (i.e. "wiggly lines" as the most salient feature for the "planet" prototype). If the person would compare the line drawings with another prototype (i.e. in triad I of the present study "dream catcher"), the other distinct feature (i.e. "crossed lines") should be most salient and guide the decision of similarity.

Suppose next, shared labels are added, as was done in Sloutsky and Lo's study (1999). Participants would ignore these, because the presented unfamiliar line drawings are treated as subordinate members of a known category (in this example "planets" or "dream catcher"). Because humans are biased that a label refers to whole objects, we deny that one label can be correctly linked to not identical objects, especially when they both are members of the same general category (Markman & Wachtel, 1988). A shared name cannot be considered correct under the assumption that the two similar, though not identical objects are subordinate members of a category. However, provided with labels that rhyme rather than being the same adults demonstrate a significant willingness to consider the rhymed label a guide for their judgment.

This may explain why the results in the present study differed from Sloutsky and Lo's study (1999). Adult participants demonstrate changes close to chance level and above chance level when verbal labels were added. This indicates that even though almost half of the adult participants consider the label as more salient they were not sure if it was expected of them to assign the presented labels or line drawings more feature weight. Some adults even verbalized their confusion when confronted with labels during their first experimental condition ("Do you want me do go by the names or the appearance?"). Further, when encouraged to choose the stimulus that goes best with the target, some adults responded: "I don't know. I will fail this test.". However, when the linguistic labels are presented auditorily and visually, the amount of change increased above chance level. Thus, when a linguistic feature is presented auditorily and visually simultaneously, its feature weight doubles and attention is drawn toward the label and salience of the linguistic feature increases. Since the effect of added linguistic features is not consistent among participants nor within individuals across all three triads there may be an imbalance in the complexity of the line drawings among triads.

Another important aspect to address is the question why participants assume similarity among objects based on the similarity of their labels. In other words, why do we judge line drawings to be more similar when their labels are similar? We know that labels are arbitrary and exchangeable. They differ from language to language in sound structure and length. We also know that because they sound similar labels do not contain similar meanings. For example, no competent speaker assumes a similarity between a table and a cable, or a train and rain. Nevertheless, results of the present study suggest

that it does make a difference for adults when performing similarity judgments to be presented with verbal and printed labels for an unfamiliar object. The key to this phenomenon is the way words are stored in our memory. During language acquisition we first store word forms in one dimension (meaning), according to themes. Later, as the vocabulary size increases very rapidly, it becomes necessary to organize word forms more efficiently for access and retrieval. Therefore, labels are re-organized on two dimensions: by meaning (in a semantic lexicon), and by word form (in a phonological lexicon). During word recognition we search in the phonological lexicon for an entry of the heard word . Many similar sounding words will be partially activated during this searching process. When the heard word is recognized the search for the meaning of the word follows and this process activates other words with similar meaning automatically and unconsciously.

Particularly the processing of the phonological structures is investigated in this study. It can be concluded that preschoolers assign less feature weight to similar labels because of their language developmental stage. On the contrary, adults are tempted to judge line drawings more similar when rhymed labels are added because they are naturally primed to search for phonological similarity. Since they are presented with unfamiliar labels the search of similar familiar word forms is very likely and increases the chance of orienting towards linguistic labels significantly increases.

Age as a Factor on Similarity Judgments

Differences of performance in similarity judgment among children and adults are noted inconsistently across all triads in the control condition and all experimental

conditions. Several factors could have contributed to that. First of all, the development of phonological awareness skills as discussed above. Second, the capacity of the auditory memory differs among the two age groups. Adults are able to store a greater amount of auditory input than preschool children (Baddeley, Gathercole, & Papagno, 1998). Therefore, the performance on similarity judgements when provided with merely auditory features differs due to the lower capacity of auditory short term memory used for holding labels in memory and processing them. That also explains the increase in changes in both age groups once the auditory linguistic features are coupled with visual linguistic features in the form of printed words. The extended availability of the labels for feature comparison secondary to the additional visual presentation supports the analysis and similarity detection among labels. Children are at a disadvantage because they are not yet literate. Nevertheless, children pay more attention when labels are not only spoken but also presented in print and therefore, the changes in similarity judgments increase also in preschoolers.

A third factor that contributes to differences in performance between adults and children is the developmental level of metalinguistic and metacognitive processes. Preschoolers do not possess a mature, adult-like ability to transfer information processing tasks to a metacognitive level. Similarity judgment tasks as they where given in this experiment required a very high level of metacognitive abilities. Further, participants had to divide their attention to analyze distinctive features of the visual stimuli and at the same time analyze the linguistic label. The task for the participating preschoolers expected them to employ a taxonomy that exceeds their cognitive abilities.

The last factor, which impacts differences in similarity judgment of children and adults is, that prototypes and salience of features within a given category are still being acquired through exposure and experience by the preschool participants. The conventional feature weights of prototypes have not yet been fully developed in these children.

Implications

This research study comes one step closer to answering the question whether linguistic labels can override visual features and if age has an effect. Sloutsky and Lo (1999) and Sloutsky and Napolitano (2003) investigated modality preferences of children because children had displayed a reliance on shared verbal labels in similarity judgments. This study follows this line of research and offers further insight in similarity judgment of preschoolers and adults when linguistic labels are not shared, but contain phonological similarity (rhymes).

Implications of this study are that the speculated preference for an auditory modality in young children may exist for non-linguistic stimuli as Sloutsky and Napolitano (2003) have been able to show, but outcomes of this study reveal no preference solely for presentation of verbal labels. Further, it can be said that children at age four are in the process of acquiring knowledge about phonological similarity and begin to organize their vocabulary on two dimensions (meaning and word from) instead of one (meaning). The phonological lexicon develops a more adult like structure, which allows for more efficacy of word recognition and word retrieval. Since the child's lexicon is growing daily, the new two-dimensional organization is a necessary step, but only

possible with phonological awareness skills. As the presented data are interpreted, between age four and five, phonology does not support and guide other cognitive processes involving linguistic labels such as similarity detection to the extent that it would override visual perception.

Further, salience of rhymed labels in adults implies that language can guide and constrain our perception of visual unfamiliar stimuli. Once linguistic skills are acquired the effect of rhymed labels on the perception of unfamiliar objects should be observable in the majority of people, independent of their linguistic background since language processing always involves a phonological and semantic processing stage.

Limitations

First of all, analyzing similarity judgment with responses of three different line drawing triads is not sufficient for solid conclusions. In further investigations, more triads need to be added to make better observations of trends and tendencies in the two age groups.

Second, as the high variability in outcomes across the three triads indicate, the nature of the line drawings may not be balanced. It is not possible to combine collected data of all three triads. Therefore, data analyses of the collected responses highly suffer in a statistical sense. By conducting numerous separate analyses, statistical power decreases that would otherwise provide better insight in statistical significance of the collected data.

Third, the number of participants in both age groups is small. To make more reliable statements about similarity judgments and feature weights, the number in each sample size has to be increased.

Fourth, the fact that the adult participant knew that the primary investigator is majoring in Speech Language Pathology may have biased their judgments according to linguistic labels. They may have assumed that it is important to orient toward the linguistic feature due to the fact that a Speech Language Pathology student is conducting this research.

Fifth, adding a condition of merely linguistic label would give better insights in the phonological awareness skills of the preschoolers. When being asked to indicate which two labels "go together" without presenting any line drawing designs, their ability of phonological similarity detection would be much clearer and inferences could be drawn about the preference of basing judgments on linguistic labels in the other experimental conditions.

And finally, repeating each condition and each triad at least twice may have provided better knowledge about inconsistent behaviors in both age groups. From this study the possibility cannot be excluded that participants guess without any specific reasoning to their response.

Further Research

The presented findings lead to further questions: Can this phenomenon of relying on rhymed labels be observed in bilingual speakers? The lexical organization of bilinguals is controversial and depends heavily on the age of second language acquisition. It would be valuable information to compare the performance of bilingual speakers to monolingual speakers. Further, since our phonological lexicon is organized according to initial sounds of words, is would be interesting to see if the higher feature weight

continues to exist when presented labels do not differ in the initial sound (as presented in this study "fami" – "nami"), but are similar in other parts of the label (i.e. "fami" – "famo"). Literature suggests that the effect should then be increasing.

General Conclusions

In sum, the present study offers valuable information on the nature of visual and linguistic feature processing in 4-year-old children and adults. Even though many results are in most cases below the chance level, tendencies are observable that shed more light on cognitive processes in children and adults. The observed behaviors indicate that children at age four are on their way to an adult-like similarity judgment pattern. Cognitive skills such as divided attention and auditory memory and linguistic skills such as phonological awareness are emerging.

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APPENDICES

Appendix A

Example of Line Drawing Designs

Figure A1. Triad I (control condition/verbal label condition).

Stimulus A placed on right side

Rhymed label auditorily provided on stimulus A or B (in spoken label condition)

Figure A2. Triad I (control condition/verbal label condition).

Stimulus A placed on left side

Rhymed label auditorily provided on stimulus A or B (in spoken label condition)

Figure A3. Triad I (printed label condition/verbal and printed label condition).

Stimulus A placed on left side

Rhymed label attached on stimulus B (also auditorily provided in spoken and printed label condition)

Figure A4. Triad I (printed label condition/verbal and printed label condition).

Stimulus A placed on right side

Rhymed label attached on stimulus B (also auditorily provided in spoken and printed label condition)

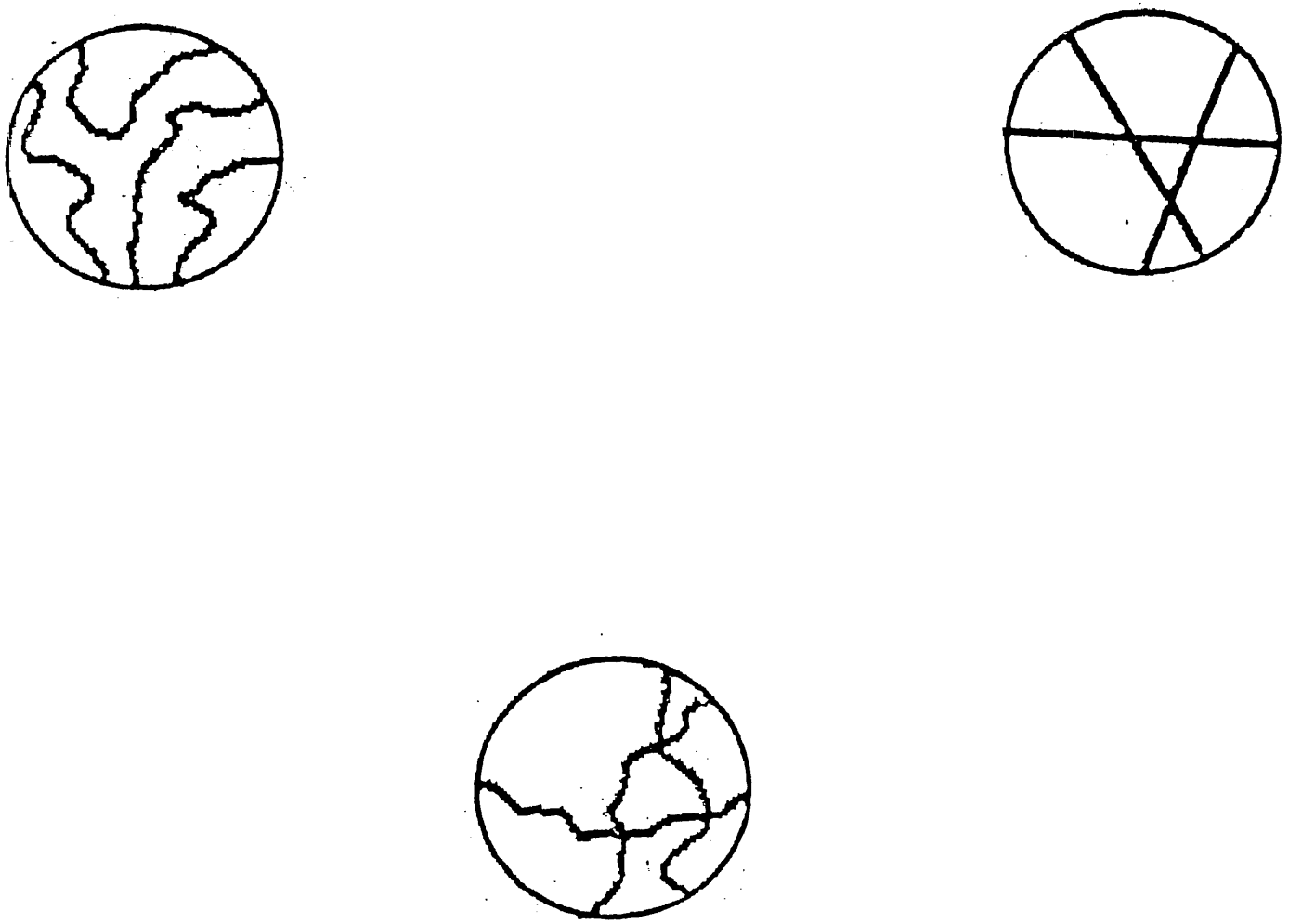


Figure A1. Triad I (control condition/verbal label condition).

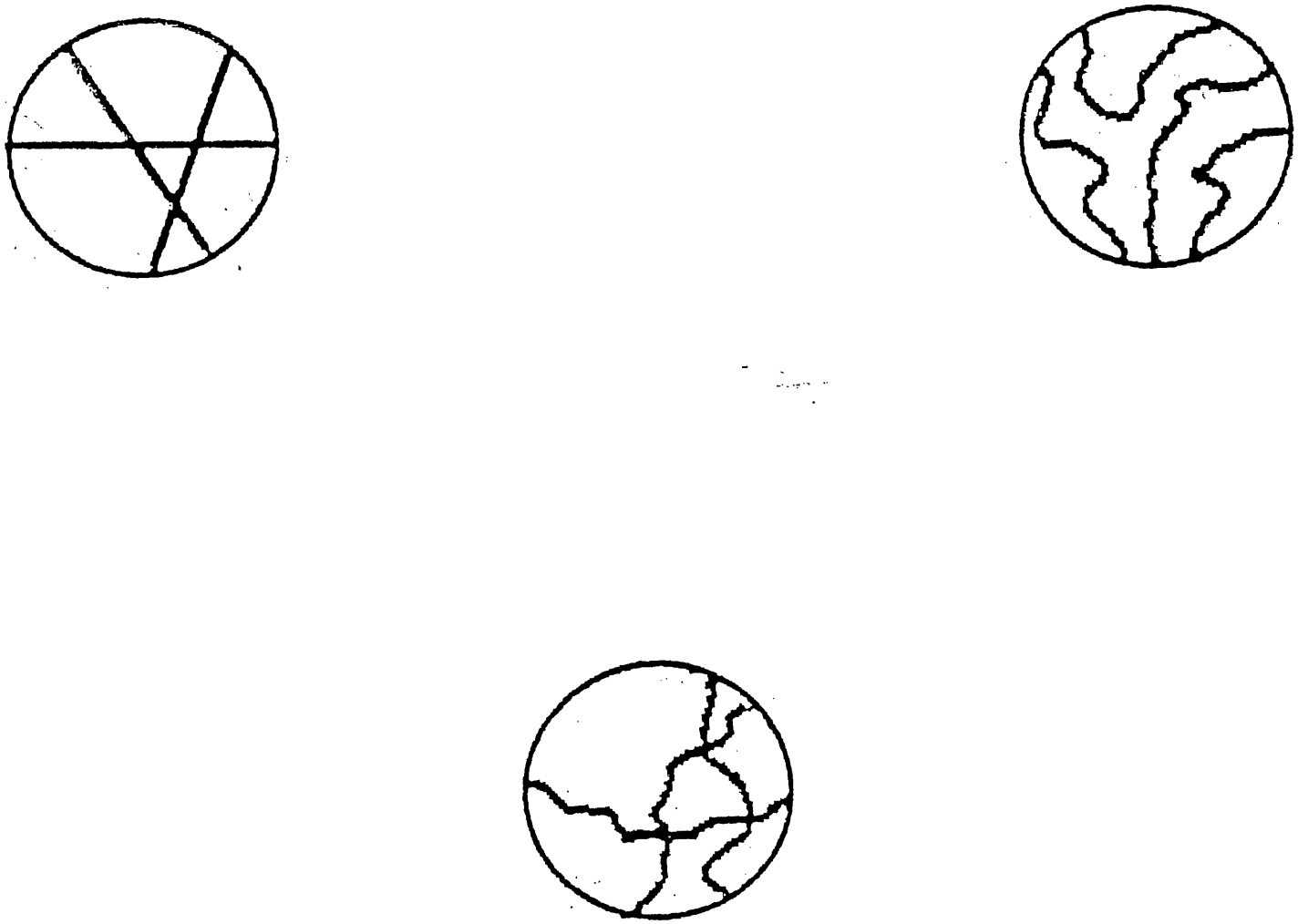
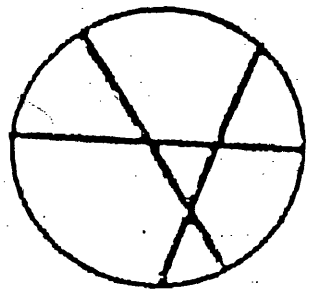
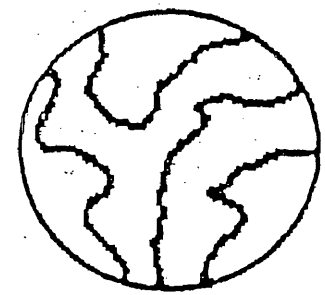


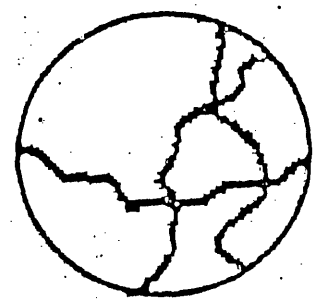
Figure A2. Triad I (control condition/verbal label condition).



suna

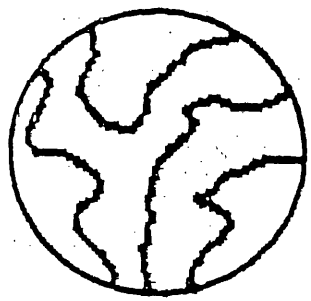


nami

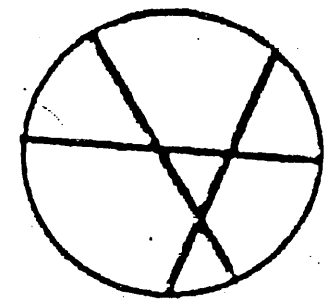


fami

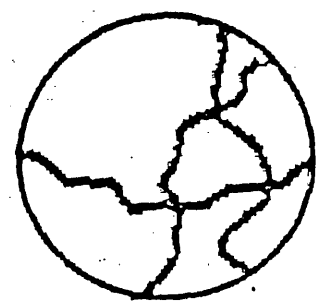
Figure A3. Triad I (printed label condition/verbal and printed label condition).



nami



suna



fami

Figure A4. Triad I (printed label condition/verbal and printed label condition).

Appendix B

Randomization Tables

Table B1. Randomizing Conditions Within Each Age Group

Condition	Children				Adults			
	Day 1	Day 2	Day 3	Day 4	Day 1	Day 2	Day 3	Day 4
Control condition	a, b, c 17				A,B,C 18			
Spoken label added		a 6	b 6	c 5		A 5	B 6	C 7
Printed label added		b 6	c 5	a 6		B 6	C 7	A 5
Spoken + printed label added		c 5	a 6	b 6		C 7	A 5	B 6

a, b, c = subgroups of preschoolers; A, B, C = subgroups of adults

Table B2. Randomization of Triads for Preschoolers

	Day 1	Day 2	Day 3	Day 4
Triad I first	6b (control)	6c (sp+pr)	6b (sp)	5a (pr)
Triad II first	6c (control)	5a (sp)	6c (pr)	6b (sp+pr)
Triad III first	5a (control)	6b (pr)	5a (sp+pr)	6c (sp)

5a = 5 preschooler of subgroup a; 6b = 6 preschoolers of subgroup b; 6c = 6 preschoolers of subgroup c; control = control condition; sp = spoken label condition; pr = printed label condition; sp+pr = spoken and printed condition

Table B3. Randomization of Triads for Adults

	Day 1	Day 2	Day 3	Day 4
Triad I first	6B (control)	7C (sp+pr)	6B (sp)	5A (pr)
Triad II first	7C (control)	5A (sp)	7C (pr)	6B (sp+pr)
Triad III first	5A (control)	6B (pr)	5A (sp+pr)	7C (sp)

5A = 5 adults of subgroup A; 6B = 6 adults of subgroup B, 7C = 7 adults of subgroup C; control = control condition; sp = spoken label condition; pr = printed label condition; sp+pr = spoken and printed condition

Table B4: Randomization of Presentation of Stimulus A on Right Side

	Preschoolers	Adults
Triad I	2a; 3b; 3c	3A; 4B; 5C
Triad II	2a; 3b; 3c	3A; 4B; 5C
Triad III	2a; 3b; 3c	3A; 4B; 5C

2a = 2 preschoolers of subgroup a; 3b = 3 preschoolers of subgroup b; 3c = 3 preschoolers of subgroup c; 3A = 3 Adults of Subgroup A; 4B = 4 Adults of Subgroup B; 5C = 5 Adults of Subgroup C

Table B5: Randomizing the Order of the Similarity Question – Version 1

	Preschoolers	Adults
Verbal Label Condition	3a; 3b; 3c	4A; 3B; 3C
Verbal + Printed Label Condition	3a; 3b; 3c	4A; 3B; 3C

3a; 3b; 3c = 3 preschoolers of each subgroup; 4A = 4 adults of subgroup A; 3B; 3C = 3 Adults of subgroup B and C

Appendix C

Rhyming Screening

Pretest Rhyming Screening Stimuli

1. ringer – supper
2. jacket – packet
3. candy – Sandy
4. cooler – paper
5. locker – soccer

Posttest Rhyming Screening Stimuli

1. Completion of phrase "Twinkle, twickle little star, how I wonder were you ..."
2. Completion of phrase " Up above the world so high, like a diamond in the ..."
3. boat – coat
4. fight – bite
5. shoe – pen
6. guga – luga
7. suna – fami
8. packet – jacket
9. ringer – supper
10. kito - pito

Appendix D

Summary of the Results in Adults

Table D1. Summary of the Results of Adults

code	age	gender	version	side	triad I				triad II				triad III				changes		
					BL	S	P	SP	BL	S	P	SP	BL	S	P	SP	S	P	SP
01	21;01	M	1	R	B	B	A	A	B	A	A	A	B	A	A	A	2	3	3
02	21;08	F	1	R	B	B	B	B	B	B	B	B	B	B	B	B	0	0	0
03	23;10	F	2	R	B	B	B	B	B	B	B	B	B	B	B	B	0	0	0
04	20;07	F	2	R	B	A	A	A	B	B	B	B	B	B	B	B	1	1	1
06	47;05	F	1	L	B	B	B	A	B	B	B	B	B	B	B	A	0	0	2
07	21;00	M	2	L	B	B	B	B	B	B	B	B	A	B	B	B	1	1	1
09	21;09	F	1	R	B	A	B	B	B	B	B	B	B	A	B	A	2	0	1
10	26;07	F	1	R	B	A	A	A	B	A	A	B	B	A	A	B	3	3	1
11	21;03	F	2	R	B	A	A	A	B	A	A	A	B	A	A	A	3	3	3
12	45;09	F	2	R	B	B	B	B	B	A	B	B	B	A	B	B	2	0	0
13	30;02	F	1	L	B	B	B	B	B	A	A	A	A	A	B	B	1	2	2
14	27;05	F	1	L	B	B	B	A	B	B	B	A	B	B	B	A	0	0	3
16	24;03	F	2	L	B	A	B	A	B	B	B	B	B	A	A	A	2	1	2
17	26;11	F	1	R	B	B	B	B	B	A	B	B	B	B	A	A	1	1	1
18	23;08	F	1	R	B	A	B	A	B	A	B	A	B	A	B	A	3	0	3
19	25;08	F	2	R	A	A	B	B	B	B	A	B	B	A	A	A	1	3	2
21	33;01	F	1	L	B	A	A	A	B	A	B	A	B	A	B	A	3	1	3
23	26;06	F	2	L	B	B	B	B	A	B	A	A	B	B	B	B	1	0	0
					A B	A B	A B	A B	A B	A B	A B	A B	A B	A B	A B	A B			
					1 17	8 10	5 13	9 9	1 20	8 10	6 12	7 11	2 16	10 8	6 12	10 8			
changes																	26	19	28

N = 18

Age range: 20;07 - 47;05 years

M = 26.7

SD = 0.42

Male: 1

Female: 17

BL= Baseline (control condition)

S= Spoken label

P= Printed label

SP = Spoken and printed label

Appendix E

Summary of the Results in Preschoolers

Table E1. Summary of the Results in Preschoolers

code	age	gen.	vrsn.	side	rhy.	triad I				triad II				triad III				changes		
						BL	S	P	SP	BL	S	P	SP	BL	S	P	SP	S	P	SP
12	4;1	M	1	L		B	A	B	B	B	B	B	B	A	B	A	B	2	0	1
13	4;7	F	1	L		B	A	B	A	B	A	B	A	B	A	B	A	3	0	3
01	4;2	F	2	L		B	B	B	B	B	B	B	B	A	A	A	B	0	0	1
06	4;11	F	2	R		B	B	B	B	B	B	B	B	B	B	B	B	0	0	0
11	4;4	M	1	R		B	B	B	B	B	B	B	B	B	B	B	B	0	0	0
02	4;11	F	1	L		B	B	B	B	B	B	B	B	B	B	B	B	0	0	0
17	4;1	F	1	L	yes	B	B	B	B	A	B	A	B	A	A	A	A	1	0	1
10	4;3	M	2	L		A	A	A	A	A	A	B	B	B	B	A	A	0	2	2
04	4;10	M	2	R		B	A	B	A	B	A	A	A	A	A	A	B	1	1	3
05	4;10	M	2	R		B	B	B	B	B	B	B	A	A	A	B	B	0	1	2
07	4;1	F	1	R		B	B	B	B	A	A	A	A	A	A	B	A	0	1	0
08	4;1	M	1	L		B	B	B	B	A	A	A	B	B	B	B	B	0	0	1
09	4;2	M	1	L	yes	A	A	A	A	A	A	A	B	A	A	A	B	0	0	2
03	4;11	F	2	L		A	A	A	A	B	A	A	A	A	A	A	A	1	1	1
15	4;4	F	2	R		B	B	B	B	B	B	B	B	B	B	B	B	0	0	0
14	4;7	F	2	R	yes	B	B	A	B	B	B	B	B	A	A	B	B	0	2	1
19	4;11	F	1	R	yes	B	B	B	B	B	B	B	B	B	B	B	B	0	0	0
						A B	A B	A B	A B	A B	A B	A B	A B	A B	A B	A B	A B			
						3 14	6 11	4 13	5 12	5 12	7 10	6 11	5 12	9 8	9 8	7 10	5 12			
changes																		8	8	18

N = 17

M = 4.5 years

SD = 0.37

Age range 4;1-4; to 4;11 years

Male: 7

Female: 10

BL= Baseline (control condition)

S= Spoken label

P= Printed label

SP = Spoken and printed label